19 AUGUST 1954 NINEPENCE

ELECTRICAL TIMES

... and the jobs BICC get down to!

Making and laying underwater cables is just one of them. At present BICC are undertaking the supply and installation of four underwater cables each cable being manufactured in one length of seventeen miles without joints. They will cross the Georgia Strait between Vancouver Island and the mainland, forming part of an order for seventy-seven miles of 138,000-volt gas-pressure type cable for the British Columbia Electric Company.

BICC also make the thousand-and-one other types of electric cable used for transmission, distribution and telecommunications—and much of their associated equipment.

If you would like to know more about our vast range of products ask for Publication No. 215; if you would learn more of our activities as an organization, you will want No. 270—"A Few Words About BICC". They are both available on request.

BRITISH INSULATED CALLENDER'S CABLES LIMITED
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THE NEW B·N·E C.90 ELECTRIC COOKER

WITH THE AMAZING SPEEDHEAT OVEN!

The outstanding performance of the "Speedheat" Oven in the B.N.E. C.90 Electric Cooker—the newcomer to the B.N.E. range—will make an instant appeal to the discerning housewife.

Here is a big "easy-to-clean" oven with a new element design which, when coupled with the highly reflective pearl grey vitreous enamel and scientifically controlled air circulation, provides remarkably quick heating with superb cooking qualities.

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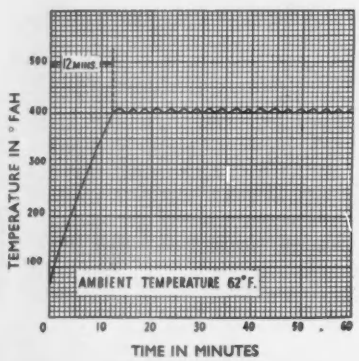

The graph alongside shows that a temperature of 400°F is reached from an ambient temperature of 62° in **only 12 minutes.**

Yes, this new "Luxury" C.90 will be a quick seller—particularly when the purchaser knows that an exclusive Pyrex heat-resisting glass casserole/grill pan, a heated drawer, and an 8" radiant plate with simmer control are all included for the moderate price of £48.

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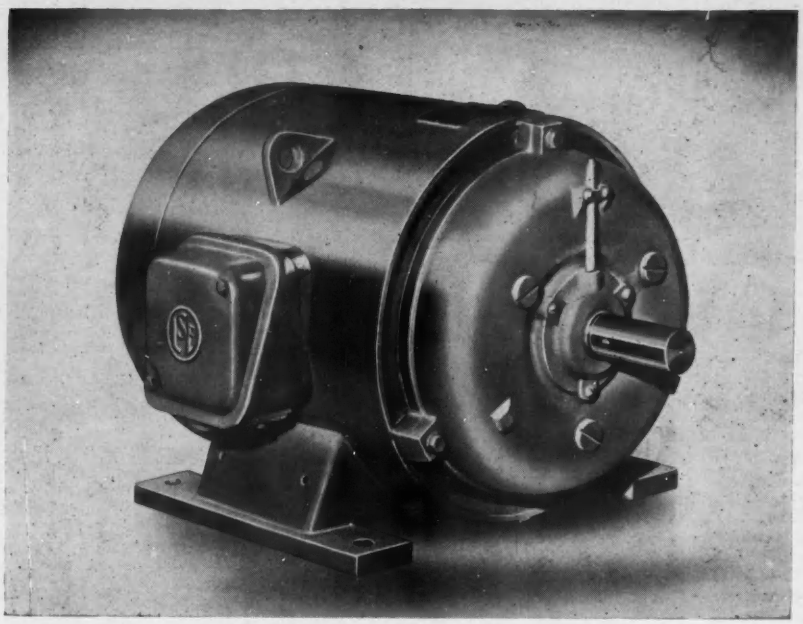
The Domestic Appliance Section of JOHNSON & PHILLIPS LTD.

NEWARTHILL MOTHERWELL SCOTLAND



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For instance, when you buy L.S.E. British Standard Dimension motors you get contemporary design and dimensions in machines made by a firm which has been building first-class motors ever since electric power was first put to work, and which has no intention of streamlining its standards of craftsmanship and quality. Again, completing the L.S.E. range of standard motors, there are available many machines of the 'made to measure' type for less ordinary requirements.

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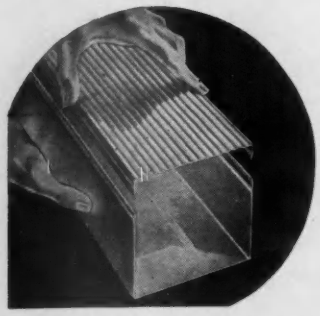

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The key on each marker ensures that the ferrules can only be assembled with the figures in line and cannot come out of alignment afterwards.

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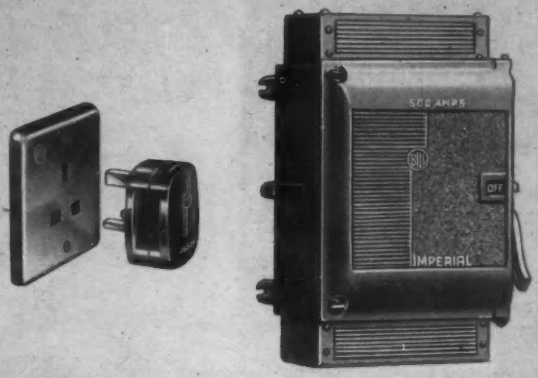

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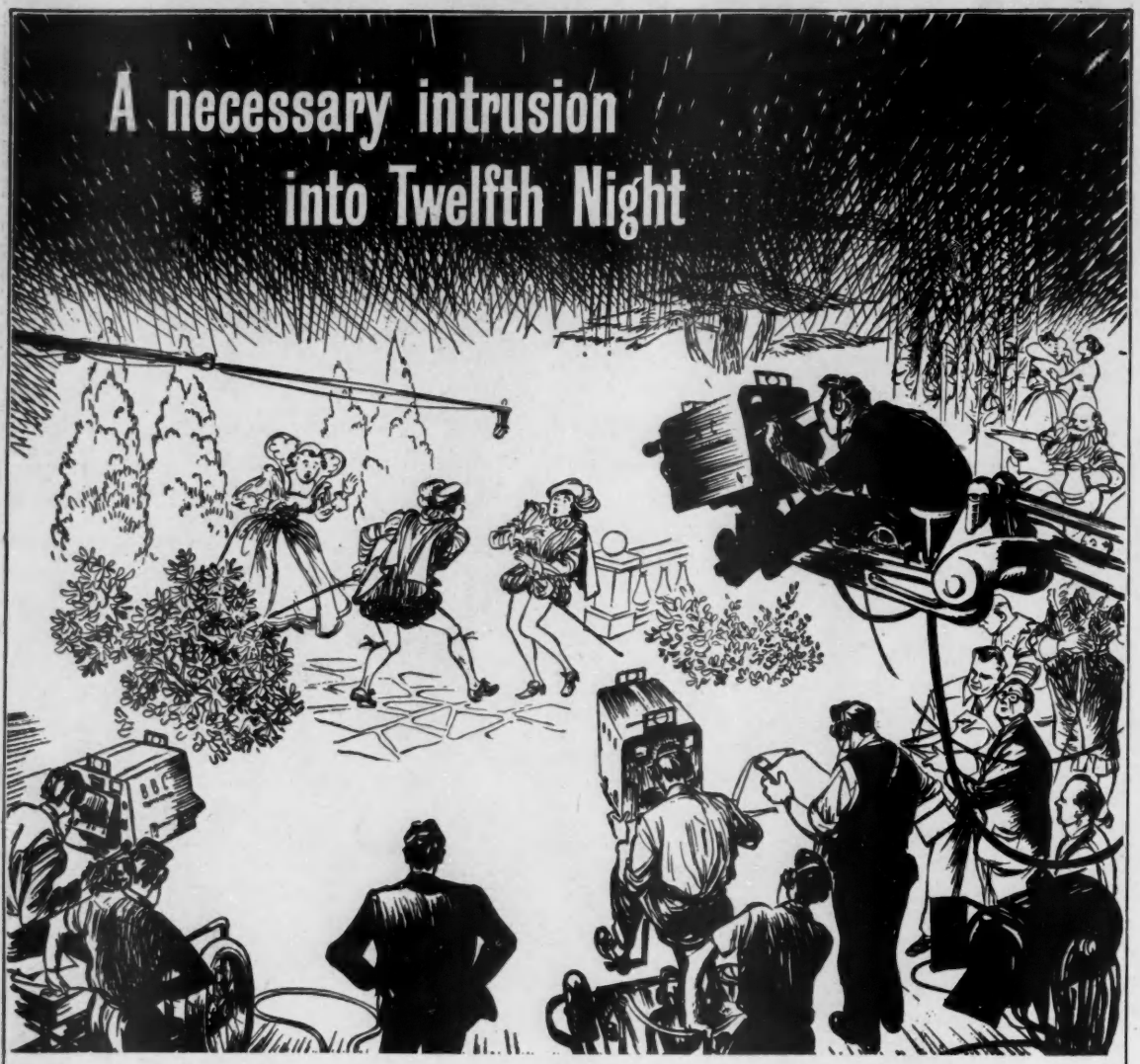
A necessary intrusion into Twelfth Night



Bringing Shakespeare to millions of viewers . . . the TV producer relies on faultless equipment. On camera and microphone cables, for example, and on the G.P.O's co-axial cable system which links most of the B.B.C.'s transmitters—and which were developed by members of the Cable Makers Association.

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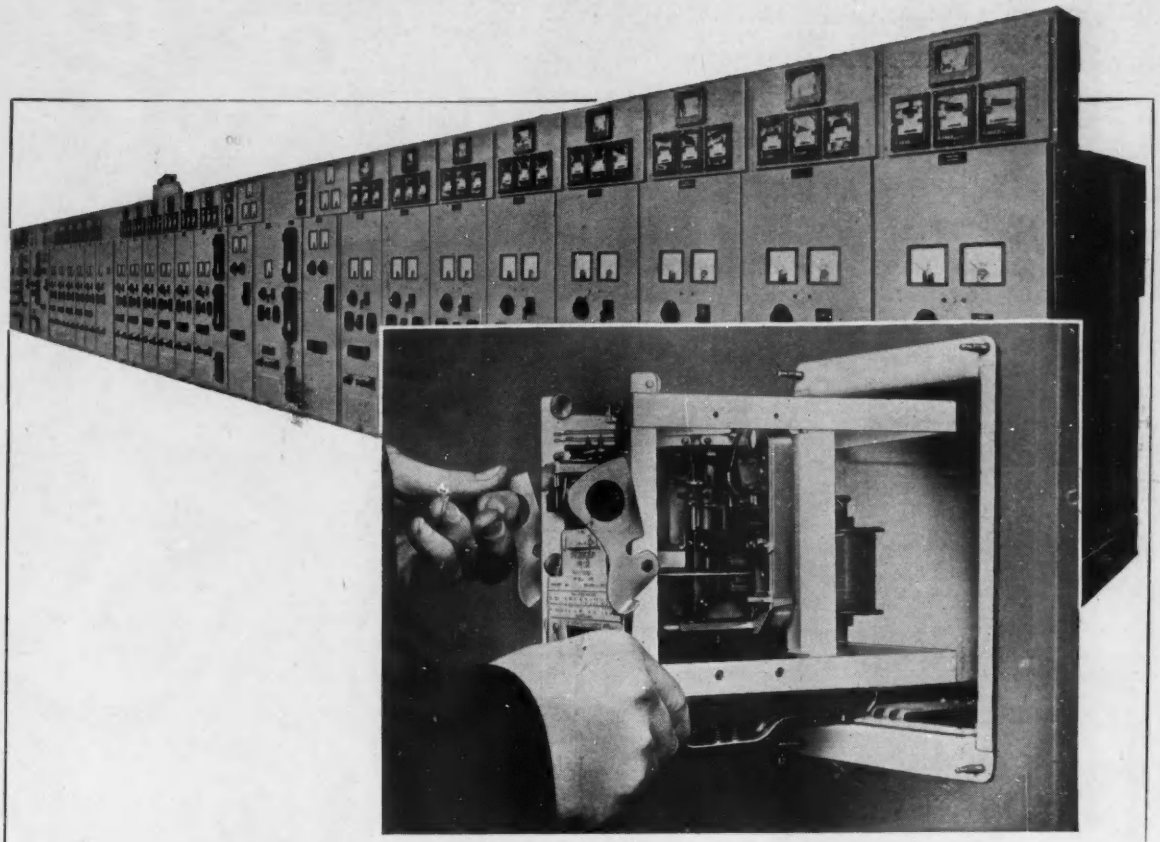

'ENGLISH ELECTRIC' relays can be completely withdrawn during service, without disturbing the panel wiring or interfering with other devices, an especially valuable feature with flush mounting relays.

A test plug enables secondary tests to be carried out with a portable test set in a fraction of the usual time because no connections have to be changed. Withdrawal of the plug instantly restores the relay to service.

Switchboards with 'ENGLISH ELECTRIC' drawout relays present a neat and attractive appearance.

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protective and auxiliary relays

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Ohms ± 10%	CURRENT RATINGS				
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2	3.54	5.00	6.12	7.07	8.66
3	2.89	4.08	5.00	5.75	7.07
5	2.24	3.16	3.88	4.77	5.48
7.5	1.82	2.58	3.16	3.65	4.47
10	1.58	2.24	2.74	3.16	3.88
15	1.29	1.83	2.24	2.58	3.16
25	1.00	1.41	1.73	2.00	2.45
50	.707	1.00	1.23	1.41	1.73
75	.578	.818	1.00	1.15	1.41
100	.500	.707	.866	1.00	1.23
150	.408	.575	.707	.818	1.00
200	.354	.500	.612	.707	.866
350	.268	.378	.463	.535	.655
500	.224	.316	.388	.447	.548
1,000	.158	.224	.274	.316	.388
1,500	.129	.183	.224	.258	.316
2,500	.100	.141	.173	.200	.245
5,000	.071	.100	.123	.141	.173
7,500	—	.081	.100	.115	.141
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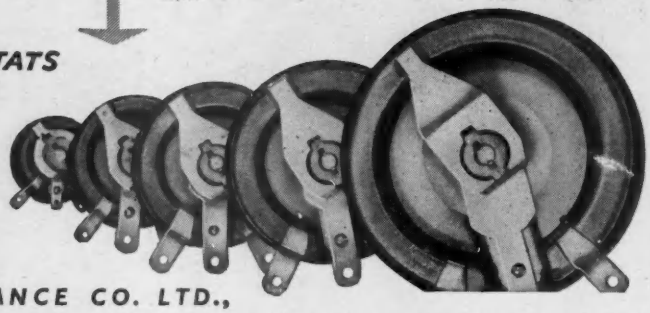

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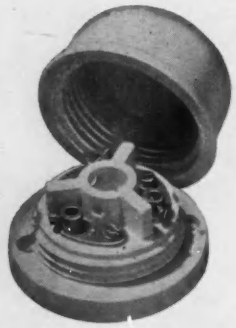

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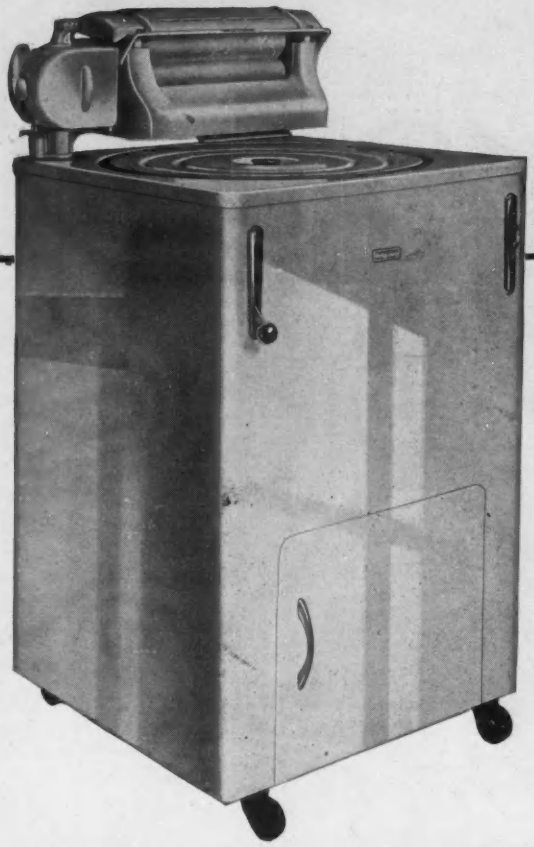

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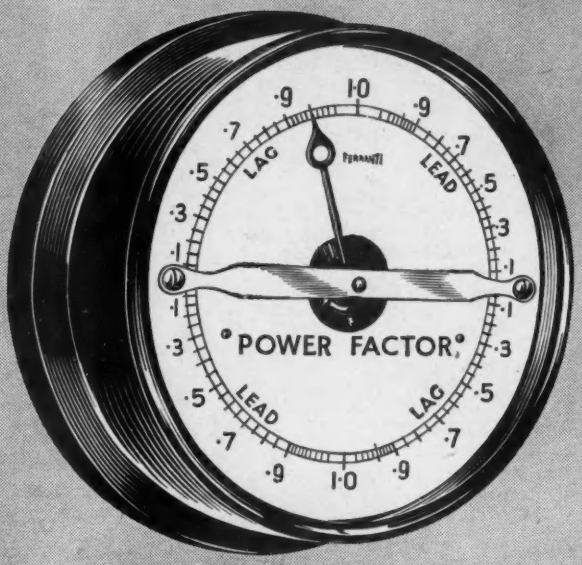
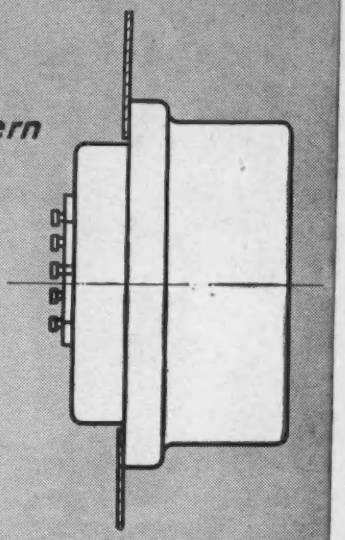


Round Pattern



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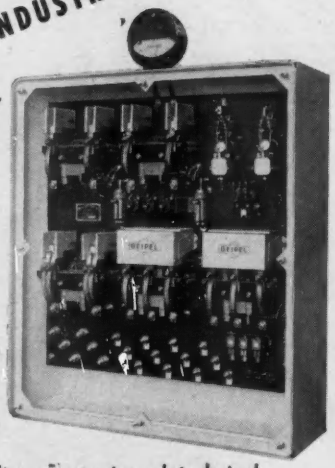

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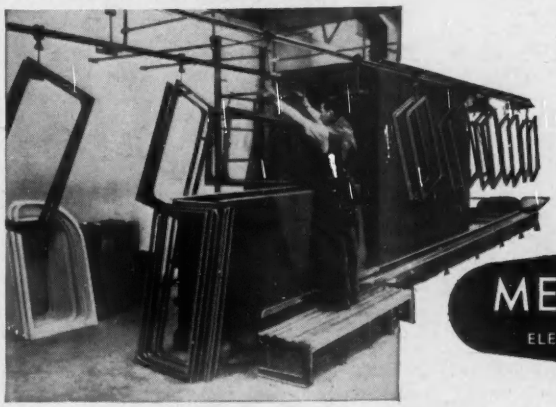

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Fig. 398 "ALL-IN-ONE" BELL
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Fig. 382 "TWO-IN-ONE" BELL
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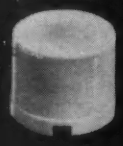

Fig. 384
MINIATURE DUO-TONE BUZZER
Very efficient buzzer for operation on D.C. for high pitch, A.C. for medium pitch, or both from two pushes.
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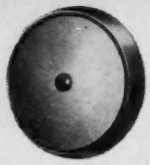

Fig. 1079
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A 7" resonant disc gong. Gives a distinctive note. Small projection, bronze finish. Flat battery inside or transformer working.
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Fig. 1132 TRANSFORMER
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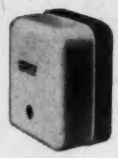

Fig. 1139 TRANSFORMER*
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Fig. 1065 UNDERDOME BELL
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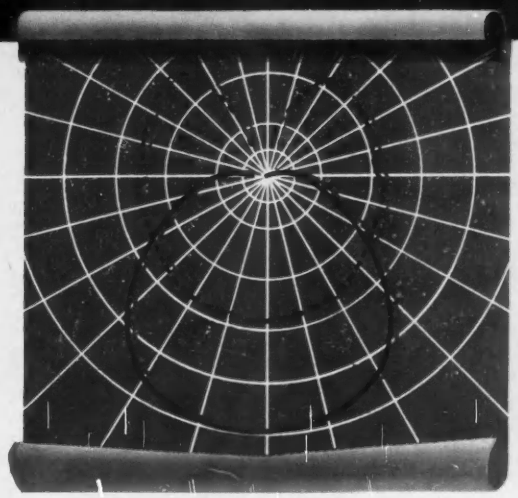

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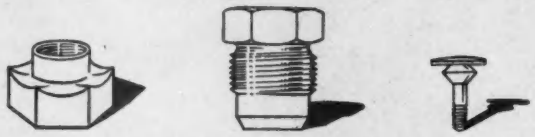

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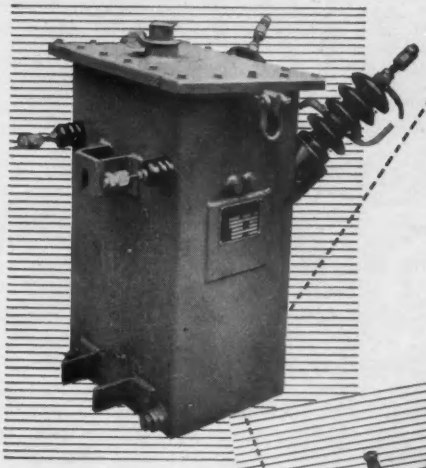
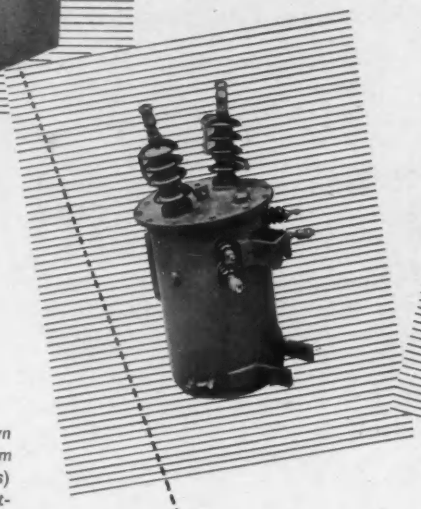
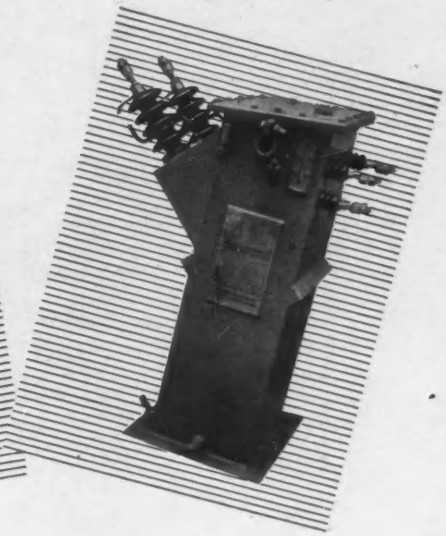


The 15 kVA "LOFEL" has an iron loss of only 80 watts, and is nstalled by Area Boards all over the country.



The 5 kVA size shown here in cylindrical form (40 watts iron loss) offers economy in initial cost. A rectangular type having an iron loss of 32 watts is also available.



The 25 kVA size (iron loss 120 watts) is shown here as a platform type; pole mounting brackets are, of course, also available.

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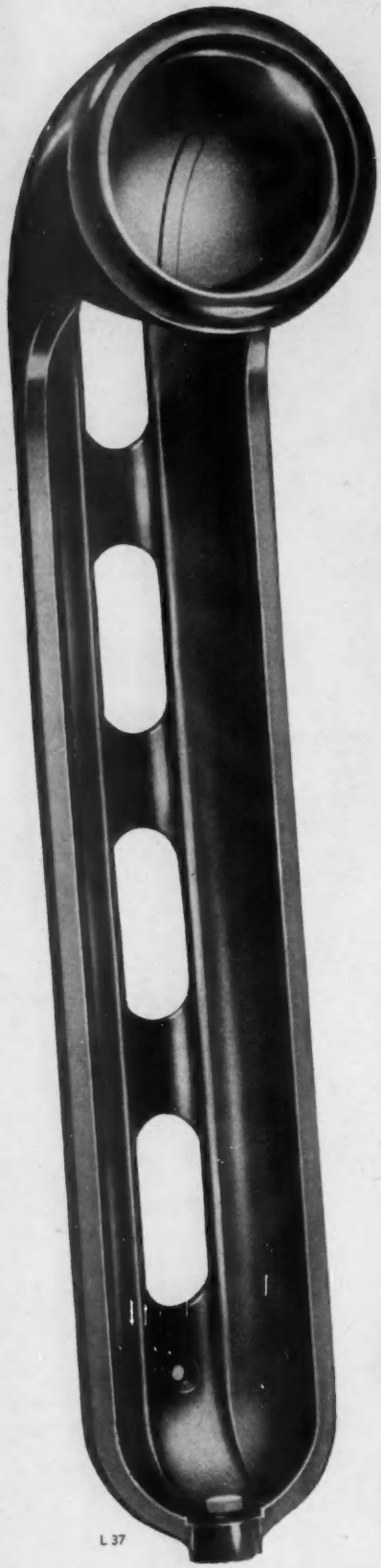

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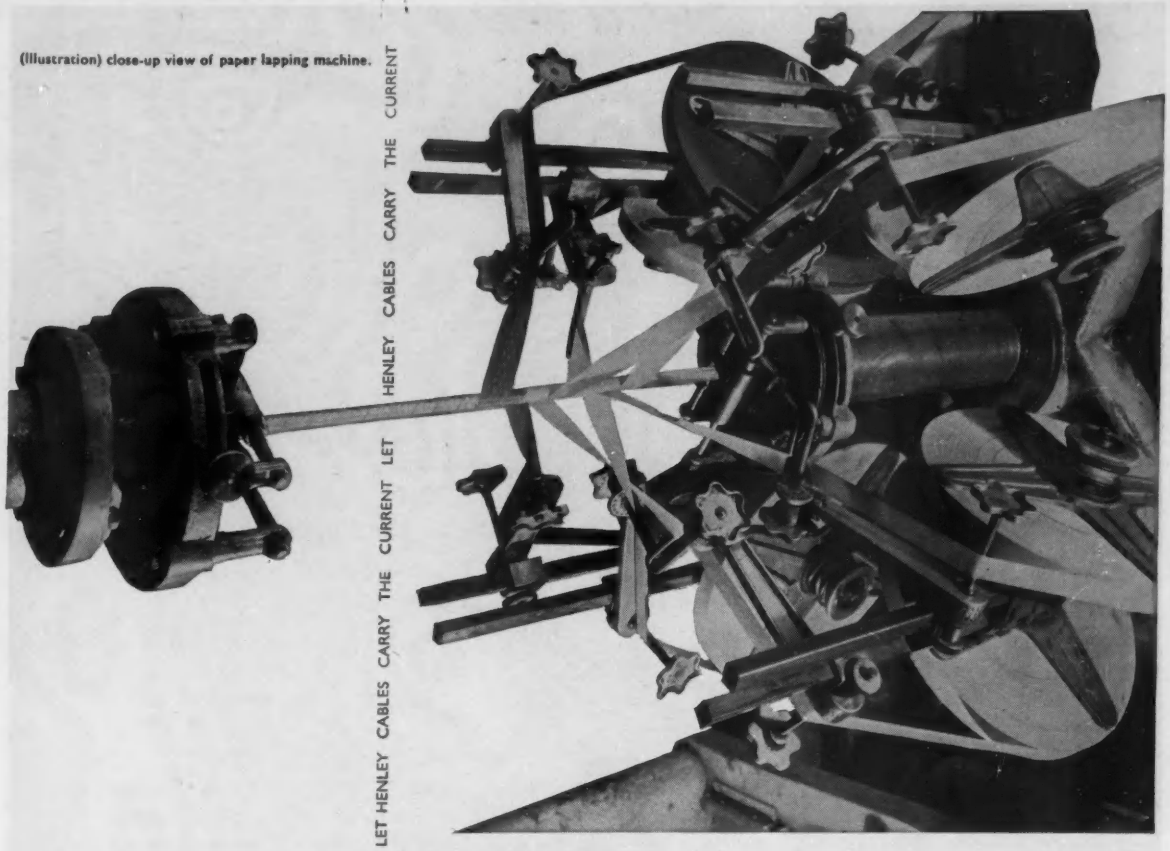

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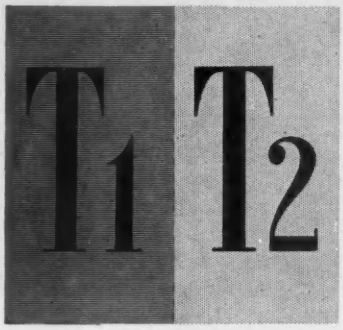

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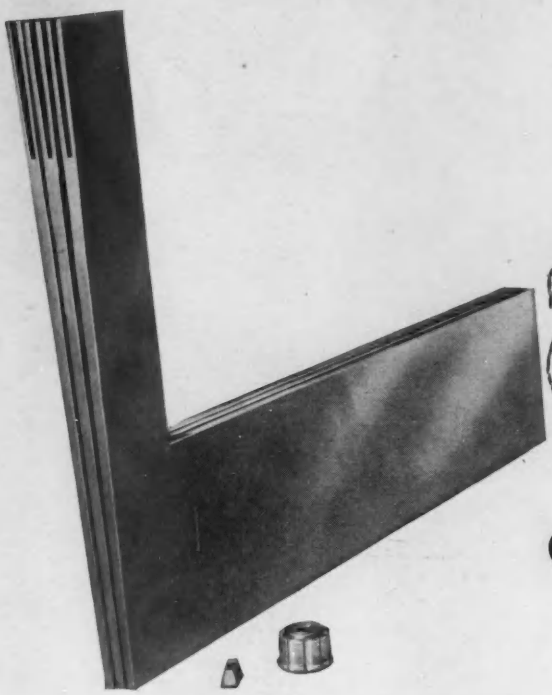

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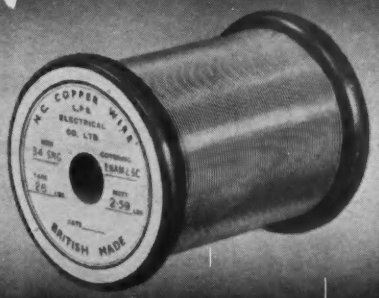

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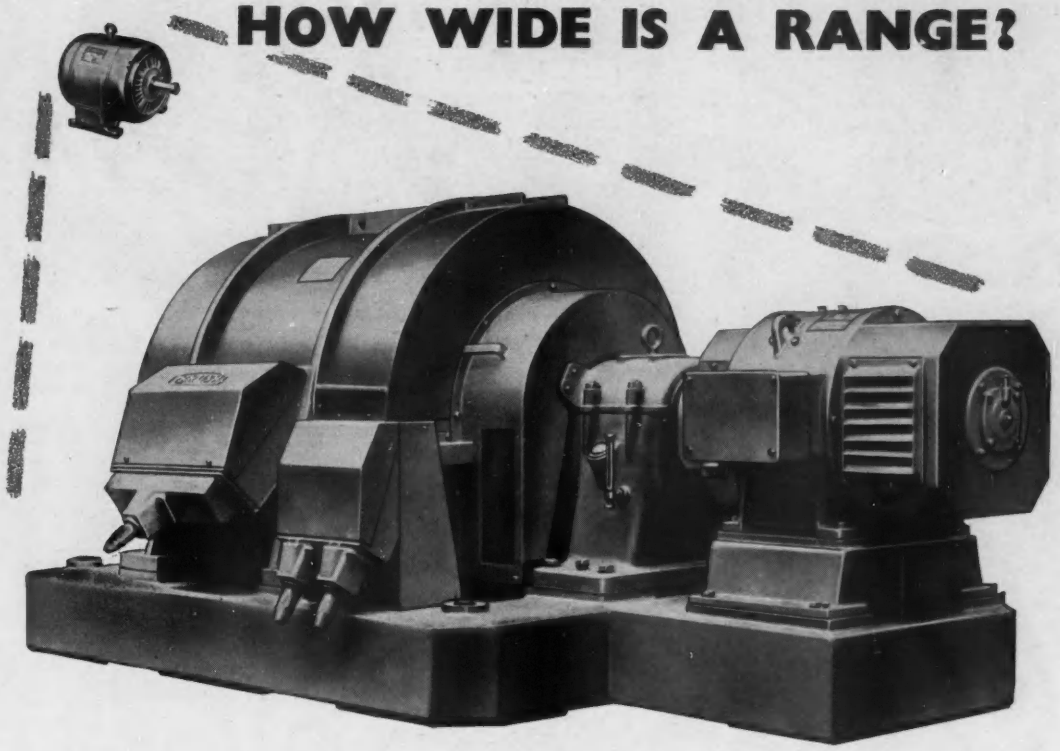

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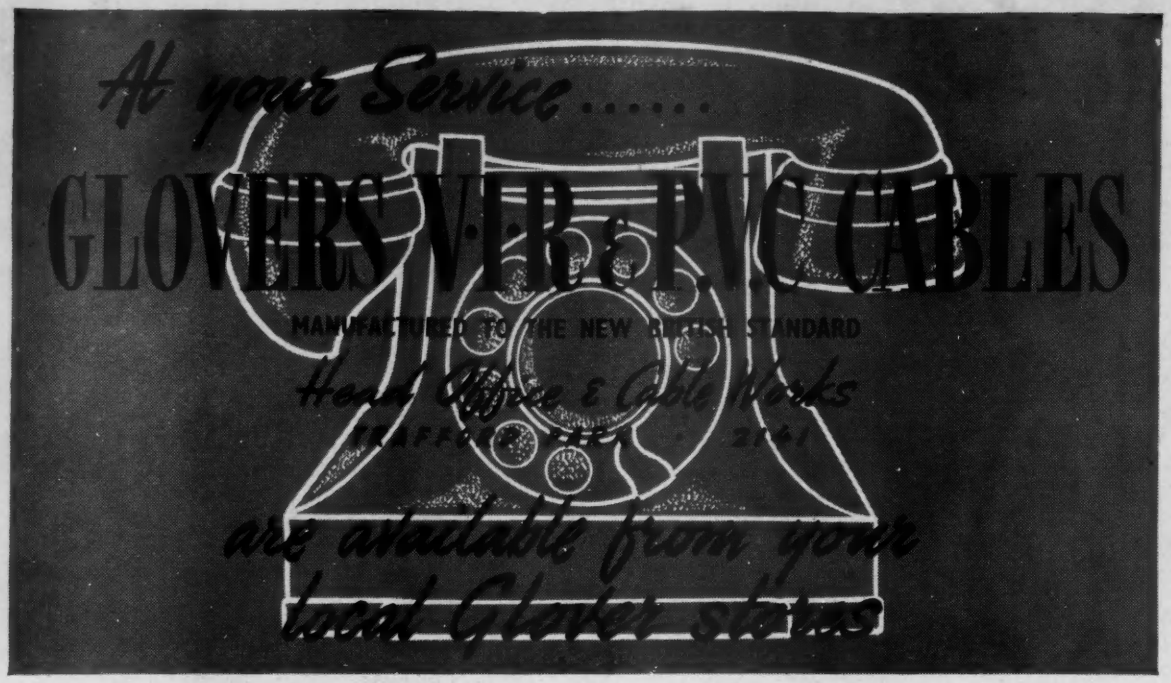
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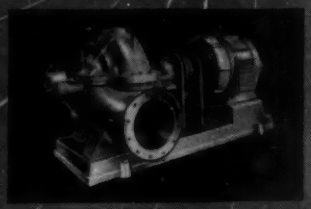

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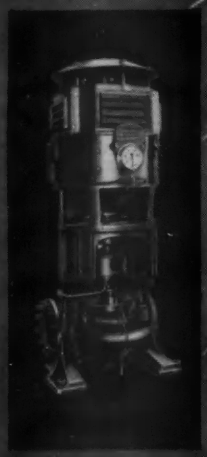

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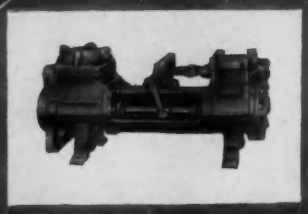

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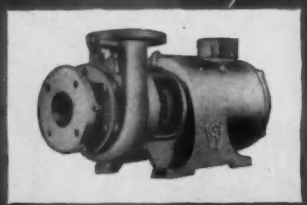

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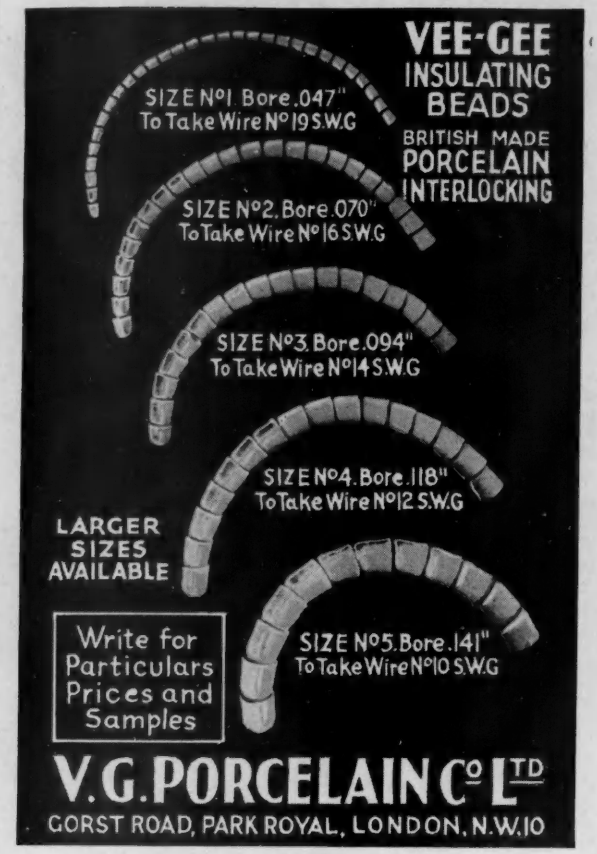

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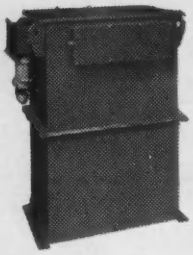

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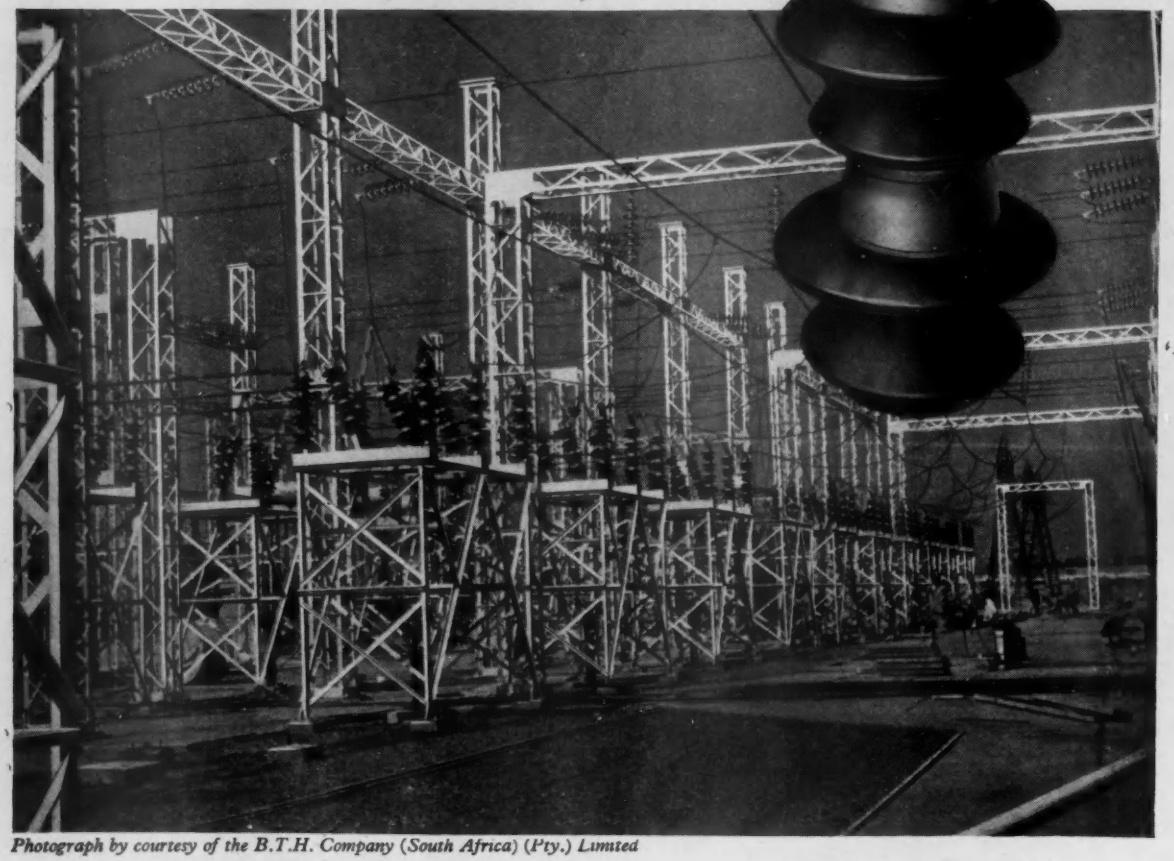

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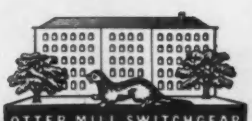

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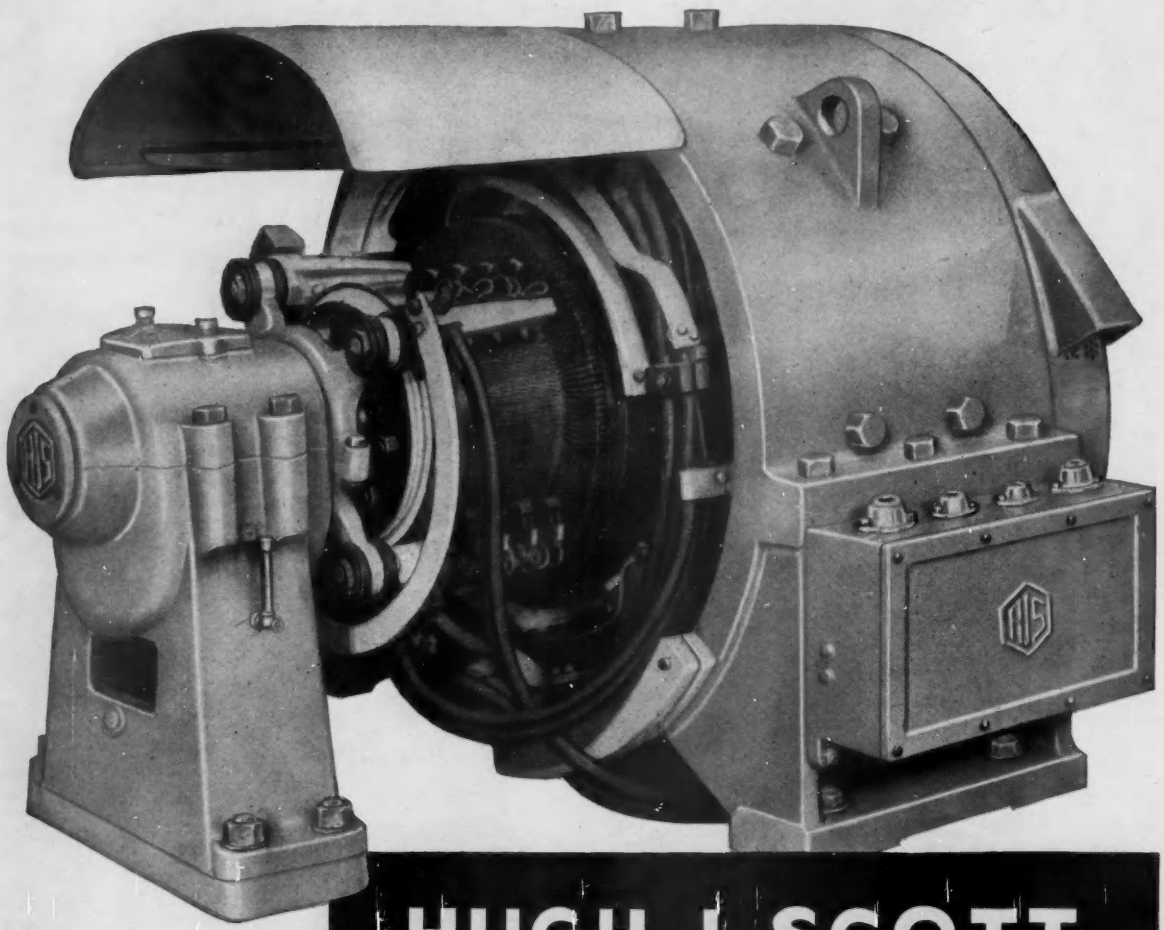

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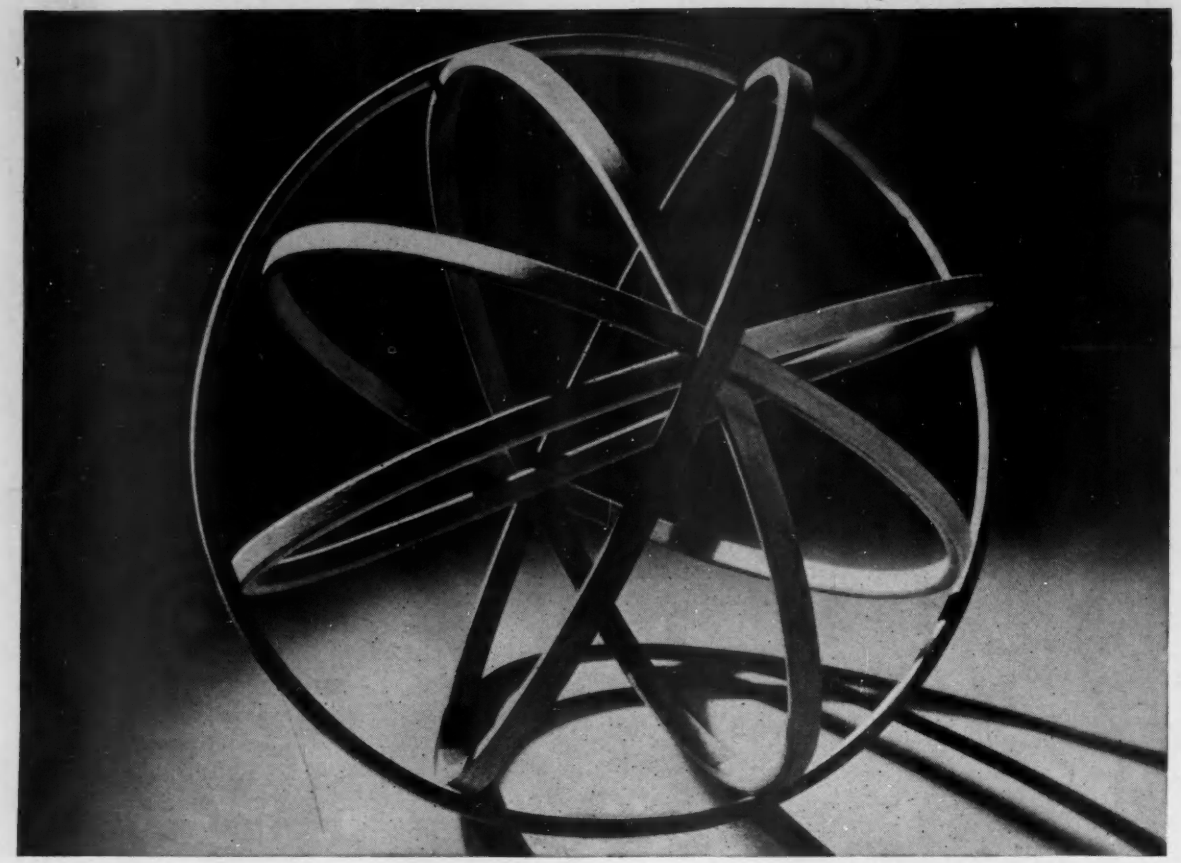

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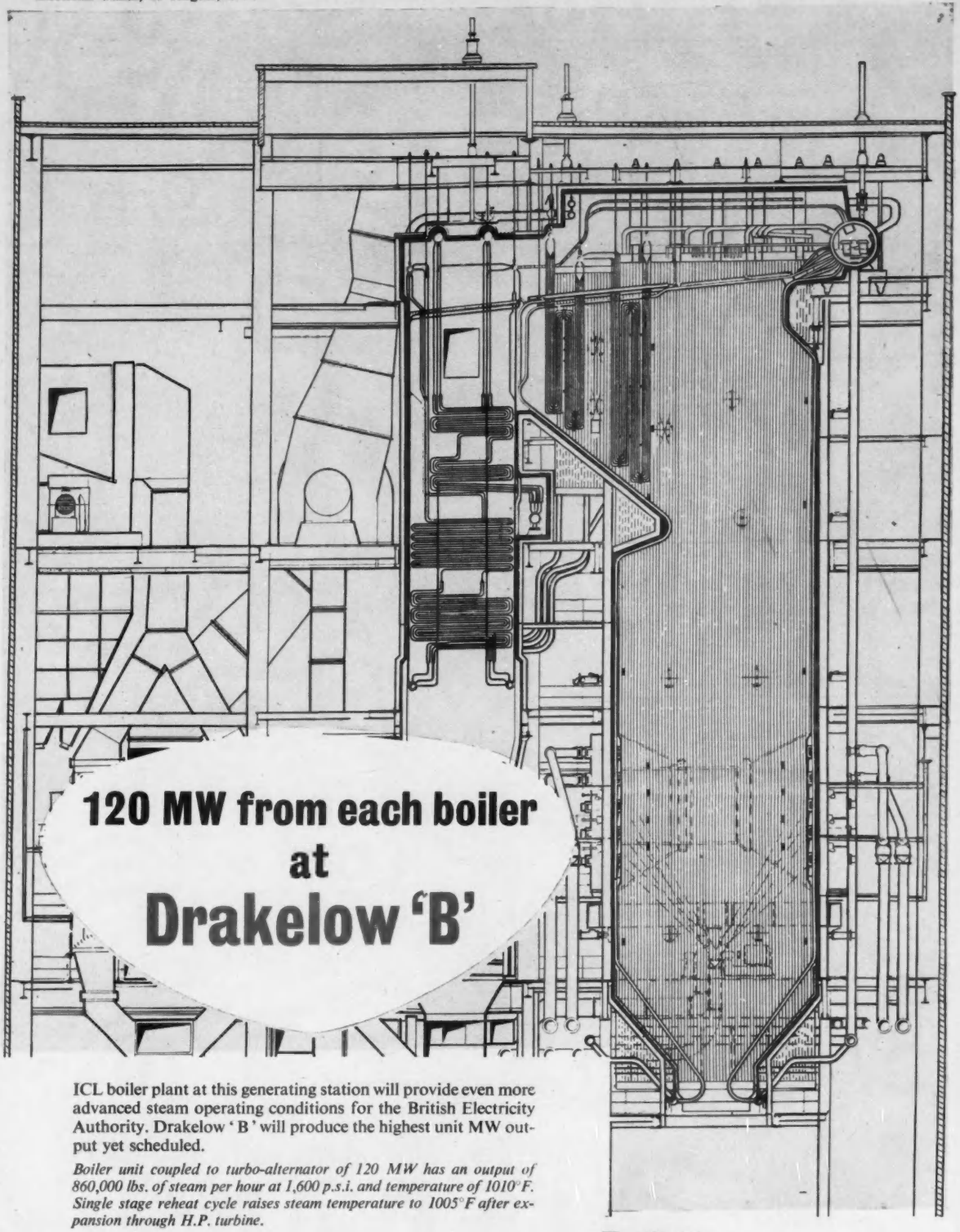

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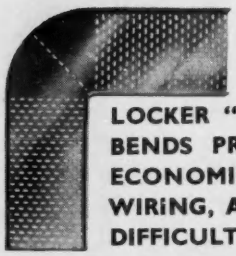

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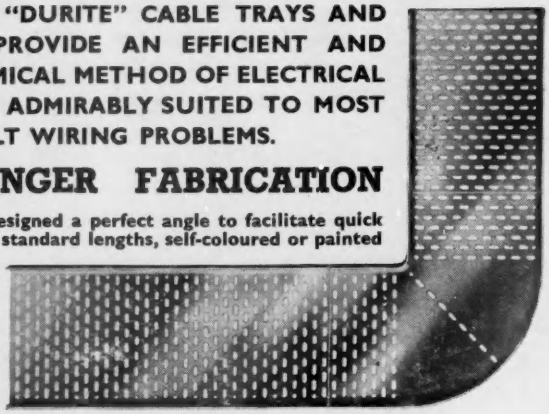

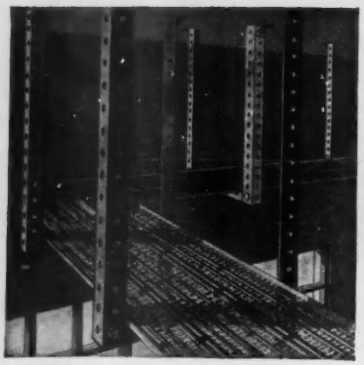

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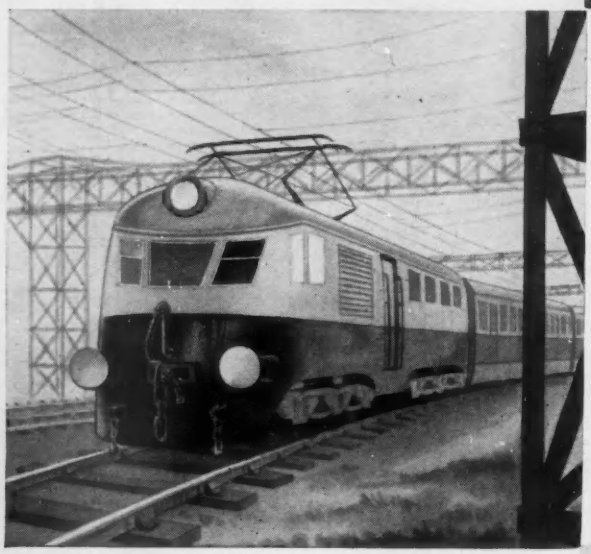

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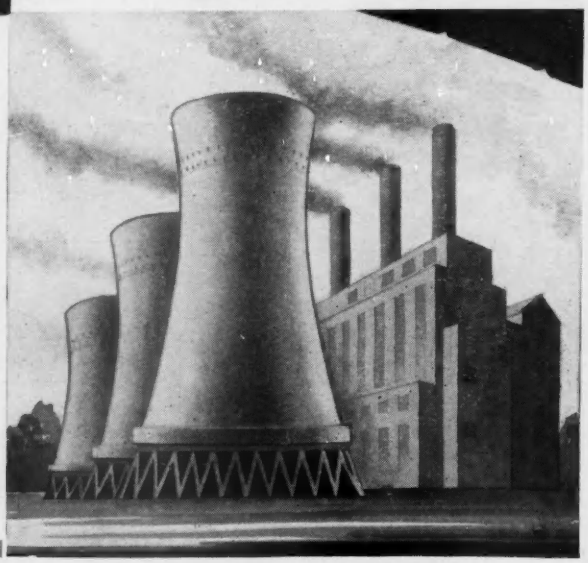

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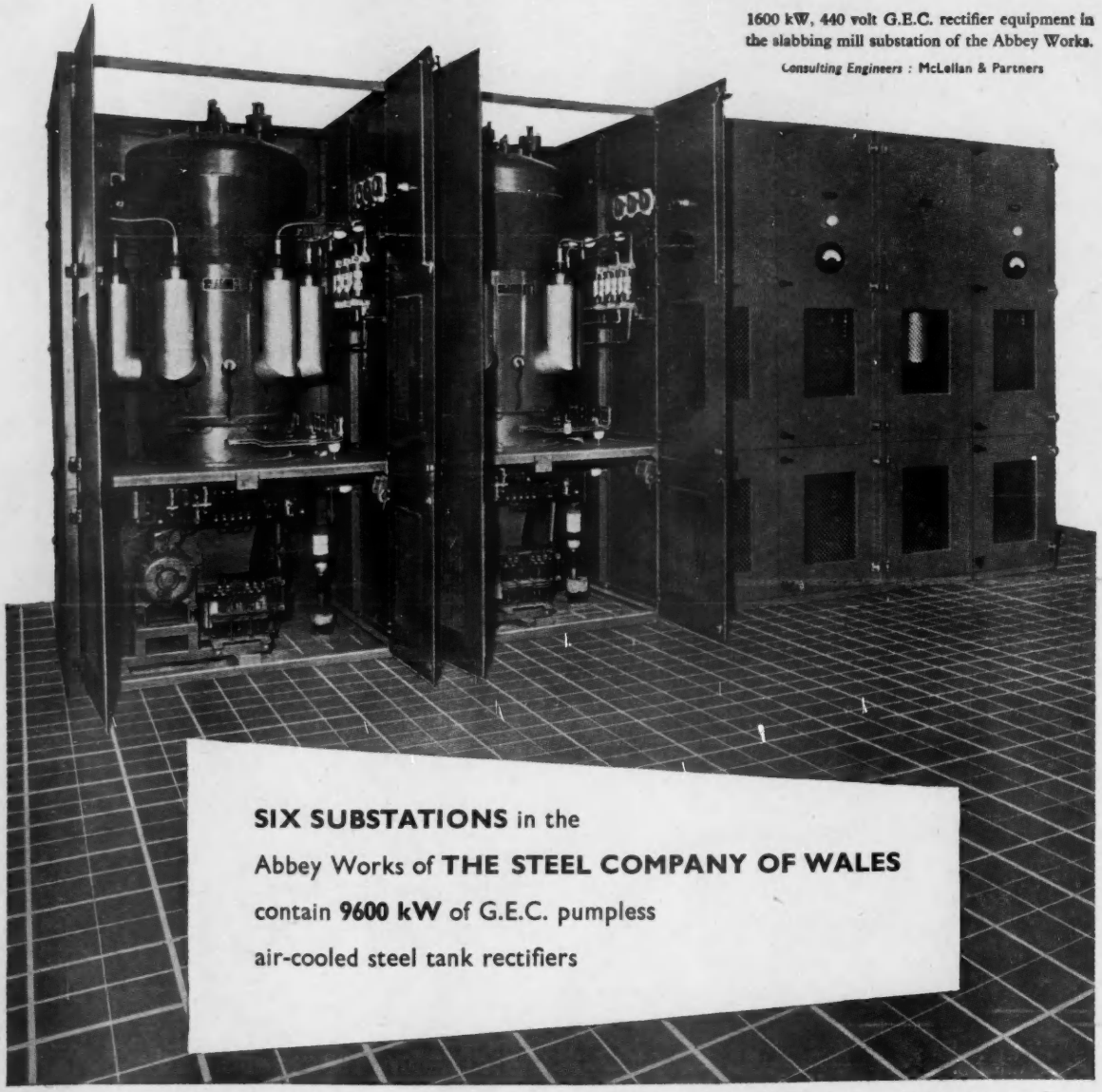

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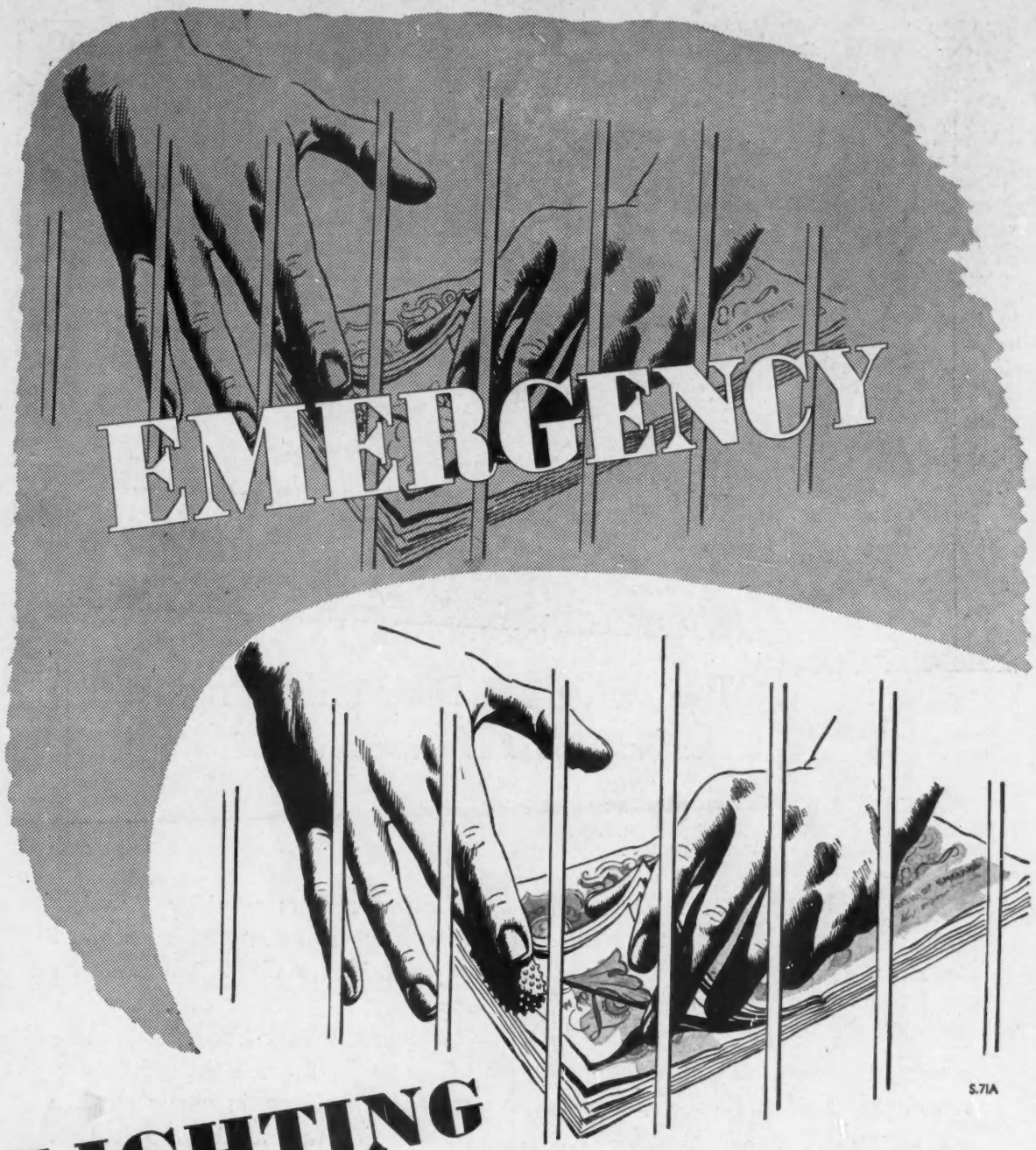

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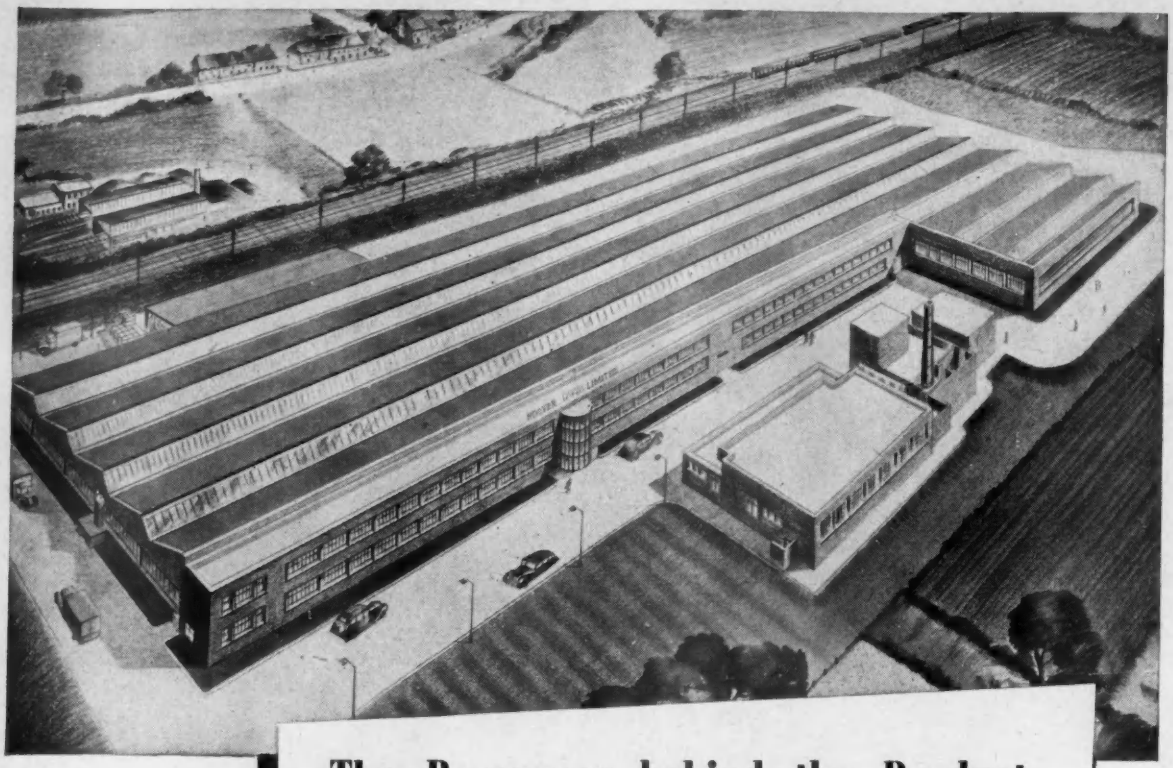

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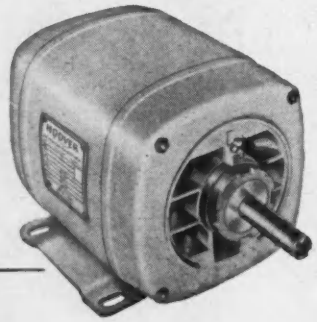

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WILL THE CUSTOMER BE RIGHT?

First announcement from Sir Edwin Herbert's committee which is enquiring into the electricity supply industry has been a request for opinions from consumers. Organisations representative of them have been invited to comment on tariffs, on the quality of the service compared with pre-vesting days, and on the effectiveness of the consultative councils. This initial concern with the consumer sounds a note of warning. The supply industry is essentially a service industry, and it is undoubtedly right that the consumers' opinions should be considered, but it is unlikely that those outside the industry can offer much useful evidence about its organisation and efficiency, which are the concerns of the investigating committee. This is certainly true as regards quality of service. For some pre-nationalisation standard of comparison it will be necessary to go back beyond 1939, for the war years can hardly count; and so great have been the social and technical changes in the last fifteen years that few significant lessons could be drawn from such a model. Moreover, the very nature of electricity supply makes it unlikely that the views of any one group of consumers will be in the best interests of all, for the workings of diversity make compromise an essential element in efficient operation. The committee will need to regard the opinions they receive with care; perhaps they principally want a basis for an examination paper to be set the industry's leaders. There can be no doubt, it is from within the industry that the main evidence must necessarily come, if the committee is faithfully to complete its task of weighing the achievements of the past seven years against the possibilities this period has held for Lord Citrine and his colleagues.

CABLE QUALITY CLAUSES

Publication of a new edition of B.S. 480 "Impregnated Paper-Insulated Cables for Electricity Supply" marks another step forward in the declared policy of incorporating quality clauses in all British cable standards. There was long debate on the advisability or otherwise of this course in the B.S.I. Committees concerned, and although the issue was effectively decided in 1949, it is of interest to recall now the contending arguments. Rubber insulated cables were at the centre of the matter, and it was considered by one side that although it was possible to publish tests which all satisfactory cables would pass, it was not possible to guarantee that in service all cables that passed such tests would be satisfactory. The opponents of this view stressed the advantages in the overseas market of being able to claim compliance with the quality require-

ments of a national standard, and users amongst them expressed the wish for that opportunity which quality clauses in a standard offer, of accepting or rejecting on a wider experience than their own. In the new edition of B.S. 480, the considerable amount of detailed testing instruction together with some specific requirements as to the materials to be used in manufacture should satisfy holders of these latter views. This is a big step from the position in the previous edition, when discussion of quality was confined to the conductor alone. For all the standard's requirements, however, the fact remains that in a branch of electrical manufacturing where attention to detail is so important as it is in cable making, purchasers are likely to continue to attach more importance to a manufacturer's reputation than to mere compliance with some published specification.

ELECTRONIC MAINTENANCE

As electronic equipment becomes more widely used in the control and operation of industrial processes, the problem of looking after it grows. Mr Swann makes special reference to this in the latest of the articles he is contributing to our Industrial Maintenance feature, and the points he raises are worthy of considerable thought. There can be little doubt that eventually, ability to diagnose simple faults in electronic equipment will be demanded of all factory electricians, but the time when this will be so is some way ahead. In the meanwhile, what are plant engineers to do? One school of thought suggests recruitment from the ranks of the radio engineers, with close attention to subsequent training in the special requirements of factory equipment; another says, find electricians with some interest in radio, and encourage them to develop their skill in maintaining electronic equipment. Probably the latter course is that which will appeal to engineers responsible for medium size installations, for however much electronic equipment may be introduced into industry, the predominence will always be with electrical power machinery, and a sound grounding in the conventional craft of the electrician is essential. Much can be done by sympathetic and ingenious management to train up suitable men, but more thought on the subject is needed by industry as a whole. How much help can be given by the technical colleges if they organise special "conversion courses"? Something of that character seems to be required, though in the initial stages there will be a need to publicise the reason behind the courses being run, if they are not to founder for lack of support. The problem is greater than is generally realised, because its effects are felt in isolated units whose main interests lie in fields other than the electrical industry. It is up to that industry, however, to produce a solution.

CHEAPER MONEY

The new B.E.A. loan announced over the weekend has been expected for some time, the questions unanswered being its size and the interest rate. In the event 3½% and £100 millions at 10s.% premium has continued the trend of such loans recently to give the B.E.A. its capital at a cheaper rate, the high point being the 4¼% stock issued at a 1% discount in 1952. With this new issue, for the first time the long term borrowing of the Authority exceeds the £700 millions written into the 1947 Act. The recent Gas and Electricity (Borrowing Powers) Act has raised the level to £1,400 millions, but it seems improbable that this will suffice for more than the next five or six years, in view of the increasing rate of plant installation that has been sanctioned by the Government.

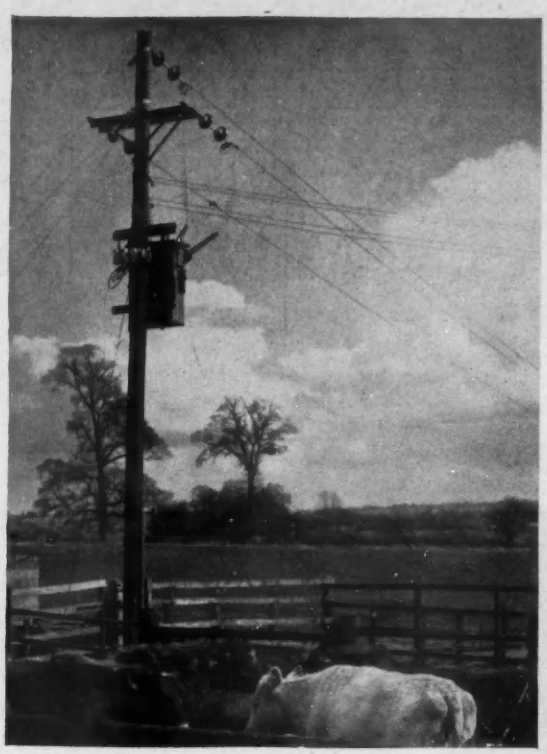
COOKER RECOVERY

Early in 1953, production of electric cookers was being out-distanced by that of solid fuel cookers. By any standards, this was a sad showing for an appliance which is the foundation of an expanding industry's drive to balance its sales to factories and the home, and to keep the prices of both to a minimum; the fact that the stock position was heavy cannot entirely explain the low level of production reached. Happily there has been a steady improvement since that time, and the latest figures available show that the output of electric cookers has this year been running at double that of solid fuel models. On average the number of electric cookers produced each month has increased by some 1,300 every month, and this rate of increase has been maintained since last autumn. The natural comparison for the electricity industry is not with solid fuel, however, but with gas. It is noticeable at once that no such increase is apparent in the production of gas cookers, and indeed, there has been some signs of a tendency for the output to fall. Proportionately, the monthly production of electric cookers has advanced from one-quarter to one-half the number of gas cookers. Encouraging though this may be, it leaves no room for complacency. Increased completion rates for houses and blocks of flats means that greater demands for electric cookers must be expected even if the industry is doing no more than hold its own with gas.

SENSITIVE SEX

Most work on electric shock is concerned with danger to life, but there is also interest in the other end of the range, in determining the minimum current to which the human body will respond. A paper recently presented to the American Institute of Electrical Engineers goes into this matter with a wealth of experimental results, but it includes, in passing, an item more generally diverting. This is a comparison of men and women from this aspect of shock perception; and the finding is, that the lady is the far more sensitive. There is no question of skins toughened by toil and others softened by beauty treatment affecting the results, for the tests were designed to eliminate such factors. They showed that the average woman can feel a 60 c/s current of two-thirds the minimum strength distinguishable by the average man. There is a value in this fragment of scientific discovery. It is admittedly unlikely that it has any practical design importance, although the perception levels tabulated in the paper could provide a rational basis for a minimum insulation resistance in domestic appliances. For the cynic, however, these results should come as a corrective to his doubting. Here at last is scientific evidence that women are indeed the more sensitive sex.

Meteor



Crossarm Weight-Span Curves

SPAN VARIATION CURVES DERIVED FOR WOOD POLE SUPPORTED TRANSMISSION LINES

By D. W. DIAMOND

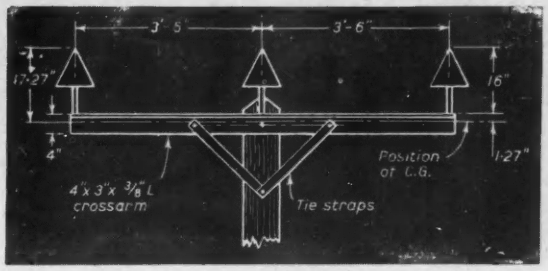


Fig. 1 (Left) Termination of a wood pole supported 11 kV transmission line. Fig. 2 (above) shows the mild-steel, straight line type crossarm for which weight-span curves are derived

WHEN plotting wood pole lines, the question of maximum span length combinations that may be supported by the crossarm under consideration frequently arises, and the designer will often be required to give some guidance with regards to the combination of maximum wind and weight spans that may be safely accommodated.

Normally, a crossarm is designed to support a given conductor with a fixed maximum wind span and corresponding weight span that exceeds this value by 50%. So that the engineer may take full advantage of the profile contour where possible, a curve similar to that illustrated in Fig. 3 is often constructed. This curve gives various combinations of wind and weight spans that will produce the same maximum working stresses in the crossarm as obtained by the loading conditions imposed by the basic design spans.

The span variation curve shown in Fig. 3 has been constructed for the mild steel, straight line type crossarm illustrated in Fig. 2 and has been calculated on the following basis:

Conductor size	= 0·15 sq in. (7/0·166") copper
Radial ice thickness	= $\frac{1}{2}$ in.
Wind on ice covered conductor	= 8 lb/sq ft on full projected area. 0·832 lb/ft
Weight of ice covered conductor	= 1·00 lb per ft
Crossarm size	= 4 in. × 3 in. × $\frac{3}{8}$ in. m.s. angle section
Maximum permissible working tensile stress—allowing a S.F. of 2·5	= (28·0 × 2240)/2·5 = 25,000 lb/sq in. (as specified in B.S. 1320 clause 3d.)

The section modulus of a 4 in. × 3 in. × $\frac{3}{8}$ in. "L" on the x-x axis is 1·42 in.^{3}: therefore the maximum permissible bending moment required to produce the maximum working stresses in the crossarm is

$$25{,}000 \times 1{\cdot}42 = 35{,}500 \text{ lb}$$

Considering a wind span of 300 ft, we have a transverse load due to wind on ice covered conductor of:

$$300 \times 0{\cdot}832 = 250 \text{ lb}$$

The lever arm of this load about the centre of gravity of the section is the height of the pin insulator and spindle plus the distance of the c.g. from the heel of the standing flange, which is:

$$16{\cdot}00 + 1{\cdot}27 = 17{\cdot}27 \text{ in.}$$

Therefore, the total bending moment of all loads excluding conductor weight and assuming no support from the flat section tie straps is given by the following, all figures in lb in.

B.M. due to transverse wind	= 250 × 17·27	= 4,318
B.M. due to weight of insulator and spindle	= 15 × 42	= 630
B.M. due to weight of crossarm	= 3·5 × 8·45 × 42/2	= 620
Total bending moment		= 5,568 lb in.

The remaining bending moment of 35,500−5,568= 29,932 lb in. can, therefore, be contributed by the weight of conductor and ice, and the vertical load required to produce this moment will be be 29,932/42=712 lb.

As the weight of ice covered conductor is 1·00 lb/ft, the weight-span length required to produce this vertical load will be 712/1·00=712 ft.

Therefore, for a wind span of 300 ft, the equivalent weight span that will produce maximum permissible working stresses in the crossarm is 712 ft. This calculation can be repeated for various wind span lengths so that the curve shown in Fig. 3 is produced.

Factors modifying simple curve

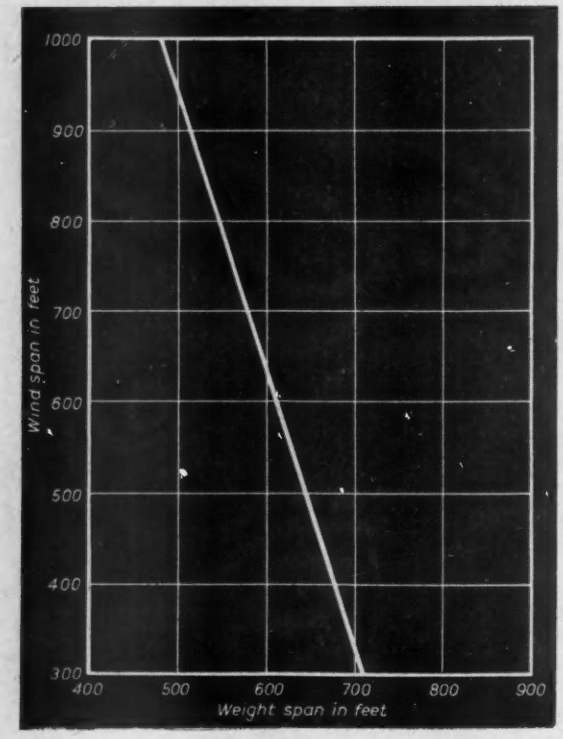
It will be seen from the foregoing that this curve assumes a flat line contour and makes no allowance for change of profile and, therefore, neglects the resulting vertical loads imposed upon the crossarm due to the downward components of conductor tensions which, at certain positions, can be of considerable magnitude. Neither does it take into consideration any upward components which may relieve dead weight and thereby allow an increase of weight-span length. Precise calculations of such components is a lengthy matter of some complexity, but certain simplifications can be introduced which give approximate values of sufficient accuracy to satisfy all the requirements of practical application. The curve shown in Fig. 3 has been modified to include an allowance for such factors and is illustrated in Fig. 6.

Considering the supports illustrated in Fig. 4a and letting T equal the maximum working tension of the conductor, it will be seen that a close approximation of the vertical component of the conductor tensions will be:

$$V = T(\text{Sin}\,\theta_1 + \text{Sin}\,\theta_2)$$

$$\text{or } V = T\left(\frac{S_1}{l_1} + \frac{S_2}{l_2}\right)$$

Fig. 3. Weight to wind span variation curve for straight line crossarms



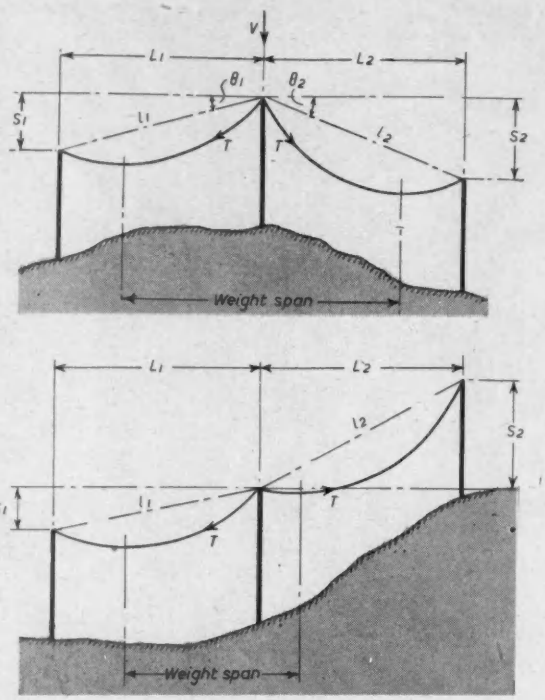


Fig. 4 (a) and (b). Typical span configurations for o.h. lines, giving the notation used in the text

The difference between true length l and span length L is small except for very short spans with sharp contour rise. In the majority of cases checked in practice it has been found to be sufficiently accurate to consider L=l so that the above expression becomes:

$$V = T\left(\frac{S_1}{L_1} + \frac{S_2}{L_2}\right)$$

$$\text{or } V = TF$$

where F is a factor corresponding to $\left(\frac{S_1}{L_1} + \frac{S_2}{L_2}\right)$

From this can be found values of V for various factors F and, for the conductor under consideration (for which the value of T is 50% of the breaking load = 4,765 lb) these values are tabulated below. As the weight/ft of ice loaded conductor is 1·00 lb, the conductor lengths giving weight values corresponding to values of component V will be V/1·00.

TABLE I.—VALUES OF THE VERTICAL COMPONENT OF CONDUCTOR TENSIONS AND CORRESPONDING CONDUCTOR LENGTHS

Factor F	Component V, lb.	Corresponding conductor length in feet
0·02	96	96
0·04	191	191
0·06	286	286
0·08	381	381
0·10	476	476
0·12	571	571
0·14	666	666
0·16	761	761

From this scale and the previous calculations made to produce Fig. 3, Fig. 6 can be constructed such that, allowing a flat profile (i.e. factor F=O) the appropriate weight span can be read from scale B by direct horizontal refer-

ence from wind span scale A. When an allowance for vertical components is required, then the horizontal reference should terminate at the appropriate factor value line from scale C and project vertically to a reading on scale B which gives the weight-span value with a reduction allowed to compensate the vertical conductor tension component.

Considering the case in Fig. 4a and assuming values $L_1=325$ ft, $S_1=9{\cdot}75$ ft, $L_2=375$ ft and $S_2=15{\cdot}00$ ft, then $S_1/L_1=0{\cdot}03$ and $S_2/L_2=0{\cdot}04$.

$\therefore$ Factor $F=0{\cdot}03+0{\cdot}04=0{\cdot}07$.

Wind span $=(325+375)/2=350$ ft.

The dotted line of Fig. 6 indicates the maximum value of wind span not to be exceeded under these conditions as 362 ft.

When a case as illustrated in Fig. 4b arises with assumed values of $L_1=300$ ft, $S_1=15$ ft, $L_2=350$ ft and $S_2=14$ ft, then $S_1/L_1=0{\cdot}05$ and $S_2/L_2=0{\cdot}04$.

$\therefore$ Factor $F=0{\cdot}05-0{\cdot}04=0{\cdot}01$.

Wind span $=(300+350)/2=325$ ft.

The appropriate weight-span value is indicated by chain dotted line of Fig. 6.

The only inconvenience of this method is the frequent necessity of interpolation between the given factor values and, as it is difficult to plot readings of all of A, B and C to convenient scales, this is often tedious. If it is desirable to avoid this inconvenience a nomogram of the type illustrated in Fig. 5 can be constructed using the notation adopted in Fig. 4, and read in conjunction with the curve shown in Fig. 3. In this method the conductor length, or variation of weight span, required to give the equivalent value of the conductor tension components is

Fig. 5. From this nomogram read in conjunction with Fig. 2 can be obtained variation of weight span required to give the equivalent value of conductor tension components

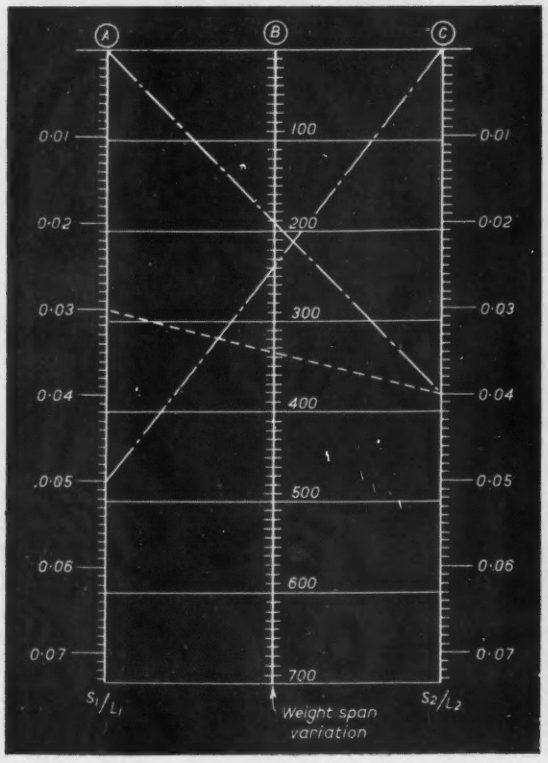
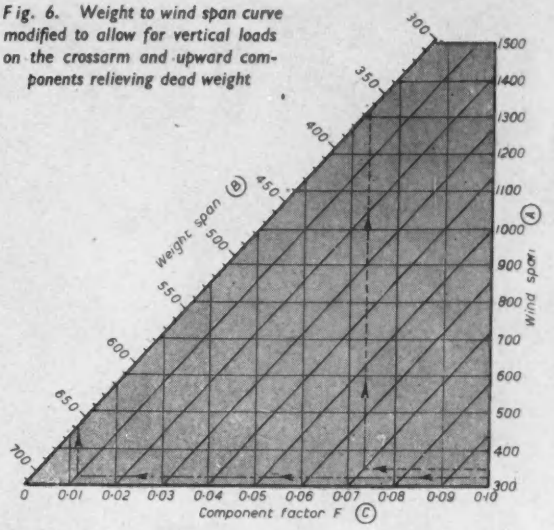


Fig. 6. Weight to wind span curve modified to allow for vertical loads on the crossarm and upward components relieving dead weight



obtained by aligning the appropriate points of scales A and C and reading the corresponding value at the point of intersection on scale B, this value being deducted from the weight-span length obtained from Fig. 3.

Example of use of Nomogram

Considering the first of two examples in Fig. 4a and outlined above:

Weight span variation shown by the dotted line on Fig. 5 = 338 ft.

Weight span corresponding to wind span of 325 ft from Fig. 3 = 700 ft.

$\therefore$ Actual allowable weight span $=700-338=362$ ft.

Values for the second of the two examples shown in Fig. 4b have been indicated with chain dotted lines in Fig. 5.

Variation in weight span due to downward component of conductor tension in span $L_1 = -238$ ft

Variation in weight span due to upward component of conductor tension in span $L_2 = +188$ ft

$\therefore$ Total variation of weight span $=118-238 = -50$ ft

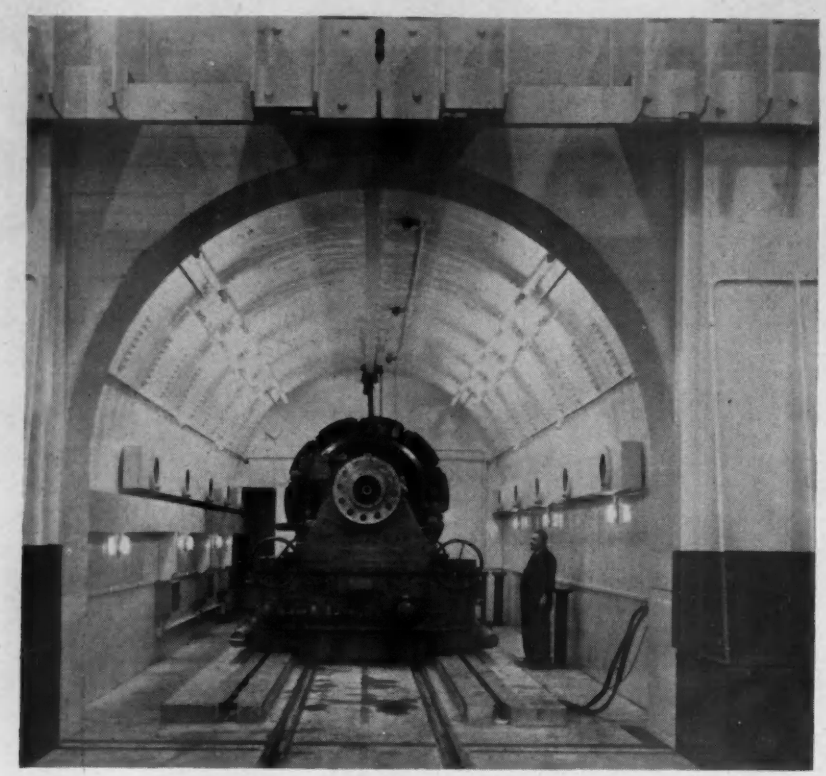
Wind span $=325$ ft weight span from Fig. 3 $= 700$ ft

$\therefore$ Actual allowable weight span $=700-50$ ft $= 650$ ft

It should be remembered that the factor F previously tabulated represented summated values of S_1/L_1 and S_2/L_2, therefore when plotting values of weight span variation for the type of nomogram shown in Fig. 5, the points of scales A and C will be 50% of the corresponding values of factor F. For example a span variation length of 476 ft will be plotted against values of $S_1/L_1 = 0{\cdot}05$ on scale A and $S_2/L_2=0{\cdot}05$ on scale C, thereby corresponding to a total value of $F=0{\cdot}10$.

It should also be noted that the methods described above have been developed to obtain weight span values only and are not intended to facilitate calculation of uplift; this problem would require a different approach.

It is believed that, for standard crossarms in constant use, the methods illustrated represent a convenient way of tabulating maximum combinations of wind and weight spans with allowance for alteration of line profile contour. The use of such methods avoid constant reference to design staff for checking of individual cases of loading and also provide a compact reference form that is readily usable by staff with little or no experience of design methods.



The overspeed and balancing house showing the tunnel with a rotor ready for balancing on the mobile bearing trolleys.

Testing Large Electrical Plant

DETAILS OF NEW EQUIPMENT INSTALLED AT RUGBY WORKS

As the size of electrical plant increases, the cost of testing becomes more expensive, both in plant and time, and although in some cases testing has to be carried out on site, it is generally regarded as important that plant should be rigorously tested prior to leaving the works. This is primarily to prove soundness of design and manufacture, to expose any minor weaknesses, to satisfy the customer that performance guarantees are being met and to enable final adjustments to be made. Secondly, however, is the fact that from these tests it is possible to take experimental measurements, frequently far in excess of the data required by the customer or specification. From this work, information can be derived of great importance to the design office.

Modern machines are so large, that except in the unusual event of there being two comparable machines in the shops, when "back-to-back" testing can be carried out, it is not practicable either to supply the driving power or to absorb the output for a full load test. Even to circulate full-load current in the short-circuited windings of a transformer requires a supply of about one-fifth of the rated kVA, and a greater proportion is needed for heat runs.

For these reasons, we were particularly interested to be permitted to view the testing facilities which have been introduced at the British Thomson-Houston Co.'s works at Rugby.

Power Supplies

In view of the large amount of kVA required, it was decided in the post-war years to install a central test generating plant of substantial capacity, both for a.c. and d.c. with provision for extension and arranged so as to supply various other places in the factory besides the new Heavy Plant section where the test plant is located.

Two main d.c. generators, driven by 2,000 kW a.c. synchronous motors have been installed. They both run at 1,500 r.p.m. and are rated at 700 V 2,400 amps. Their output, and that of a number of smaller auxiliary sets is used chiefly for testing large d.c. motors, or for powering the d.c. motors used for driving alternators in the Heavy Plant section of the factory. They are also used, however, for supplying the driving motor of the new overspeed test section. Arrangements have been made for these two d.c. machines to be connected in parallel, series or individually.

The a.c. generating plant had to meet the conflicting requirements of simultaneous availability in diverse places, and of occasional large demands in any one spot. It was therefore subdivided into units of various sizes. Alternators of 20, 5 and 1 MVA were first installed, each being driven by a synchronous motor, a further 5 MVA alternator is being erected, and provision has been made for a further unit of 10 MVA. The incoming supply is at 12 kV and this voltage is also used for the test alternators' output. All the alternators have similar characteristics so that they can be used in parallel if necessary, and satisfactory load-sharing attained. By using the motor of one of the d.c. generators as a synchronous condenser, an output of 28,000 kVA has already been obtained and used for testing the first 120 MVA, 275/132 kV transformers for the B.E.A.

One side of the test plant room with the 20,000 kVA alternator and its motor in the foreground. Note the closed circuit cooling system adopted on all machines

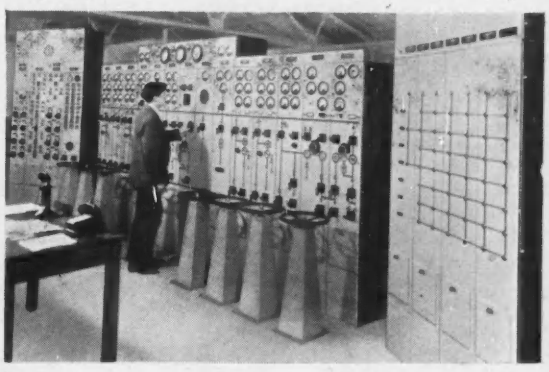
In this form of parallel operation, two important conditions must be satisfied. First the electrical "line-up" between each motor and its alternator must be exact to provide for satisfactory load-sharing, and second the excitation system has to be such that the alternator voltage control remains the same irrespective of the number in parallel, or the distance away from the machine of excitation control. This is achieved by the use of auxiliary amplidyne exciters, whose control fields are placed in series when their parent alternators are connected in parallel.

The a.c. output from this plant is made available at five points in the Heavy Plant Factory, in the Generator Factory, in the Turbine Factory and in the Motor-Compressor Test House, which is one-third of a mile away. At each location there is full control of alternator voltage, switching, and protection; or, if the two d.c. generators are used as a Ward-Leonard system (provision for which is made) of frequency. Interlocking for safety and fault protection has been provided on an extensive scale. The selection of any one, or several, alternator outputs for any test station is accomplished by a simple switching operation. A central control room provides the test staff with a complete picture and over-riding control. A miniature control board gives a complete picture of the condition of the system at any time.

Testing Facilities

Each machine has a closed-circuit ventilating system with water coolers, and the bearings, plain journal type with ring lubrication, are also water cooled. By this means it has been possible to overcome the problem of heat dissipation in a limited enclosure and to reduce the noise. Starting of the sets presented a problem, and this has been solved by providing one a.c. and one d.c. set only with pony-motor starting. Once one of these sets has been run up, usually the a.c. unit, the other sets are started on the variable voltage output from the set before being synchronised on the main 12 kV incoming line. The synchronous motors are considerably smaller than the alternators whose main duty is to supply kVA.

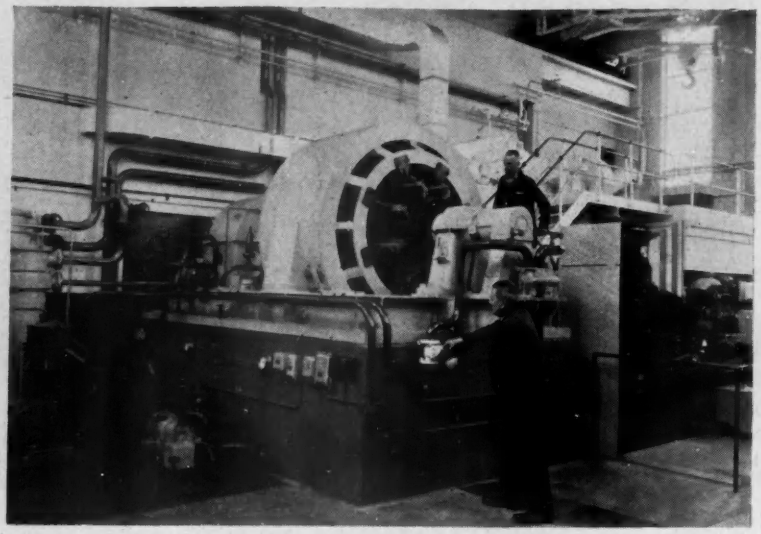
For testing transformers, at over-voltage, a special supply has been provided which can be channelled through the main test supply network. This consists of a 250 c/s supply provided by a special alternator rated at 4,000 kVA for short periods. Measurement of the induced voltage is by means of a direct-reading and peak voltmeter reading up to 900 kV made by Haefely of Switzerland. Now that earthed-neutral systems for high voltage systems are largely used, separate-source high voltage tests above 100 kV are unusual, but must not be overlooked. A set of three transformers is therefore available, each rated for 350 kV and capable of cascaded operation. By this



The central test control board to show metering and mimic diagram

means over 1,000 kV at 50 c/s can be obtained when required. So far, the highest requirement has been for 700 kV. Also provided are other plant transformers of various ratings designed to "match" the requirements of machines and transformers to the test alternators, the largest having a capacity of 30 MVA.

For taking measurements, enclosed test-houses containing instruments and controls conveniently grouped, have been built adjacent to the test stations, thus eliminating the instrument tables and confusing wiring so frequently seen round a machine on test and enabling readings to be taken and decisions to be made in a quieter atmosphere. Specially-designed voltage and current transformers of exceptionally high standard are used to permit measurements to be taken at low power factors without corrections, and special low power factor polyphase wattmeters are provided.



Driving motor room in the overspeed test house. The oil coolers and pumps are also shown on the left, while the main contcctor board is on the right

For carrying out overspeed testing is a new rotor balancing and overspeed test house which has recently been commissioned. Although designed primarily for the rotors of turbo-alternators, it is large enough to accommodate waterwheel alternator rotors up to 14 ft in diameter, as well as the largest turbo-alternator rotors so far envisaged.

Overspeed Test House

The building is divided into three sections. First there is a preparation room, into which rotors are brought by railway trucks, from which they are lifted by a 120-ton crane, and then placed into bearings mounted on motorised carriages which move under power along a rail track into the overspeed tunnel. Second is the tunnel itself, 18 ft in diameter and 48 ft long, built of reinforced concrete and lined with timber and sand, and finally there is the motor room with its associated control room. Once inside the tunnel, the weight of the rotor is taken off the bearing carriage wheels by hydraulic jacks and the carriages are then bolted down.

The motor drive is taken to the rotor via a gearbox and a long torque shaft which in effect provides a flexible coupling. As accurate lining-up is essential to avoid spurious out-of-balance readings, an accurate, rotatable lining-up disc is included which allows a clock gauge to be used between it and the rotor coupling face. This also considerably accelerates the lining-up operation.

The separate gearbox has several sets of gear ratios available to permit the plant to deal with both high and low speed rotors, and the d.c. motor is a 3,000 h.p. (peak) unit supplied from the generating plant in the central test generating station, only the exciter set being supplied locally. Smooth acceleration is achieved by Ward-Leonard control, and equally important is ease of regenerative braking carried out by the same means. The largest rotor can be stopped in a few minutes.

Controls are grouped in a specially-designed panel in a separate compartment, and on the panel are indicators which show that the extensive gravity-fed lubrication system is functioning correctly.

In addition the panel also houses the electronic balancing gear, in many ways the key to the successful operation of the whole plant. Once a rotor is in the central tunnel, and the supply to the motor is switched on, it is impossible to gain access. A system of interlocks on all doors is designed to prevent the possibility of any person being in the tunnel while a rotor is running above inching speed. No provision is made for visual observation or any mechanical connection with the rotor or its bearings has been made. Seismic vibration pick-ups, mounted on the bearing pedestals, generate a voltage which operates direct-reading instruments in the control room, and a vibration amplitude of 0·0001 in. can be rapidly detected. Equally important, the angular position of the out-of-balance forces at each end of the rotor, relative to an arbitrary position on the shaft, can be accurately measured, and this facility permits balance to be attained in a very few runs before the rotor is subjected to overspeed.

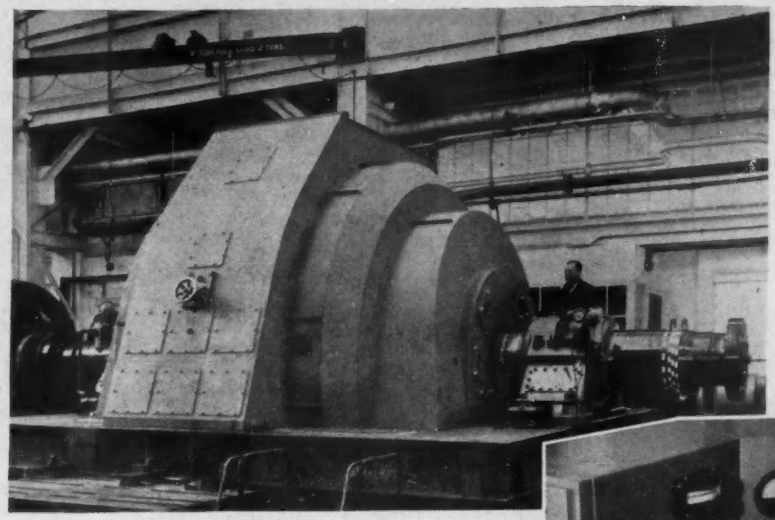
While a rotor is in the test house for balancing and over-speeding, certain other work can be done. A heavy-current d.c. generator is installed for heating and drying out windings, and a high-voltage transformer and regulator provide for high-potential tests on rotor windings.

Insulation resistance to earth, and winding resistance can be measured while the rotor is still inside the overspeed tunnel.

Plant Under Test

When we had a look at the test plant last week, two large waterwheel alternators were completing works tests in the shops. One of these, for New Zealand, was a 44,444 kVA, 136 r.p.m. alternator for Roxburgh, and the other was a 35,294 kVA 375 r.p.m. horizontal machine for Finlarig Power Station of the North of Scotland Hydro-Electric Board. It is unusual that two machines of this size should be tested simultaneously in one manufacturer's works.

Each of the first four sets at Roxburgh consists of a BTH vertical waterwheel alternator driven by a Francis turbine made by the Dominion Engineering Co. of Montreal. To ensure that the alternators comply fully with the stringent guarantees laid down in the contract, one machine has been fully assembled in the factory and a most comprehensive set of tests carried out. The remain-



On the left is the water wheel alternator for Finlarig Power Station of the North of Scotland Hydro-Electric Board. The two Pelton wheel turbines will go on the overhung shafts. Below is the control room of the overspeed test house. The deflection of bearings is shown on the right hand panel, and on the oscilloscope on the left hand section.

ing three machines will be checked for mechanical accuracy and subjected to such electrical tests as are practicable. The most important of these is a ring flux test on the stator prior to winding to check the core losses. To avoid possible deterioration while awaiting erection, certain parts, including stator sections have been cocooned and fitted with individual crane slings passing through the cocooning.

The rotors are fairly conventional, consisting of laminated rims held on to the spider by taper keys. On to this rim are keyed the poles, and the field windings are of the "jig-saw" type with corner joints silver soldered and fabricated out of solid strip. A heavy damping winding is included in the pole faces and consists of copper bars brazed at the end to copper plates embedded in the pole body. This gives effective damping on the quadrature axis without the necessity for pole-to-pole connections.

The machine being built for Finlarig is entirely different, being a double overhung Pelton wheel unit, of which the hydraulic part was designed by Boving and Co., London. Each runner weighs about 5 tons and consists of a forged steel disc to which are bolted 18 buckets of cast stainless steel. The jets, two for each runner, are each controlled by needle valves, which when fully open allow a jet of water 7½ in. dia, and travelling at 190 m.p.h. to impinge on the buckets. Power developed is 42,000 h.p. under a head of 1,250 ft.

The alternator, with an m.c.r. of 35,294 kVA, 11 kV is designed to withstand with ample margin, the stresses at runaway speed, which in the case of a Pelton wheel it reaches a maximum of twice normal running speed, i.e., 705 r.p.m. To cope with this speed, the rotor consists of a shaft, on which are shrunk and keyed a number of steel plates. Completed, the rotor and poles weigh 127 tons, but for transport all sixteen poles and four of the rotor plates can be removed to bring the maximum load down to 77 tons. An unusual feature in this machine is that the main exciter is located between the stator and one of the outboard bearings thus reducing the length of the set. When installed, the machine can be operated by remote control from Killin.

Speaking at a Press Luncheon held at the works, Mr W. S. Steele, Commercial Director, pointed out that to date the buildings and equipment had cost somewhat over £1¼ m. This represented a large amount of capital expenditure. When this factor was taken in conjunction with the long-time factor inherent in manufacturing electrical plant of great capacity, it could be seen that stored-up capital was exceedingly high in the heavy plant industry. At the same time, it was remarkably affected by changes in the economic situation or in slumps. At the moment the Monopolies Commission was investigating the working of B.E.A.M.A. He hoped that they would take into consideration that heavy plant could only be gauged on a long-term basis. If they were to use the past three years on which to base their judgment, they would not get the right answers and the future for the industry would indeed be black. Trade setbacks would probably occur within the next ten years and unless capital was ploughed back into heavy industry the second largest exporting trade of the country might go under with disastrous consequences.

Inhibited Oils

Over the past seven years experiments have been carried out by Shell-Mex and B.P. Ltd., using Shell Diala Oil B.X, a refined mineral oil containing a compatible oxidation inhibitor for use in transformers. The results of practical tests over the past four years have proved most satisfactory. In no case, where the transformers were flushed before filling with inhibited oil has there been any development of acidity, and even where some of the old oil was left in the transformer, the original neutralisation value has remained constant. This inhibited oil can thus be confidently recommended for use in cases where oxidising conditions are unusually severe. It is not at the moment recommended for normal use as it has been found that transformer oils to the current B.S. Specification have proved satisfactory for the majority of applications.

READERS' VIEWS

Correspondents writing under a pseudonym are asked to submit their names in confidence to the Editor

The Simplicity of Earthing

HARD on the heels of your editorial comment on this subject, in fact in the next issue of your journal, comes an editorial on "A Contractor's Liability." The latter refers to an Assize Court case in which an electrical contractor was sued for damages following the electrocution of a young housewife by a defective electric wash boiler earthed to an 18 in. earth stake placed in the earth outside the front door of the house. It was given in evidence that no one had measured the resistance of the earth electrode when it was put in which was at the same time that the wash boiler was installed.

I feel I must strongly endorse your statement that it is a good maxim always to test the earth connection, as even if what appears to be a metallic water mains system is readily available for earthing purposes, the growing practice of using asbestos water mains, allied to the ever-present possibility of a relatively high resistance at the transformer neutral earth, renders even this method suspect.

In the particular instance in question the contractor's simple way of earthing, without test or check on its efficiency, cost him £530. 6s. in damages. I hope that other contractors who adopt the same simple way of doing the job will reflect on both the moral and financial aspects of this unfortunate case.

J. A. Robbins, B.SC., A.M.I.E.E., A.M.I.MECH.E.,
MARLBOROUGH, WILTS.

Partition Walls

I AM very sorry to note that "Megohm" has construed my comments as an attack upon himself, as this was not the intention. If attack there was, it was directed to those who will not under any circumstances admit a substitute for steel conduit, however adverse the conditions for its use may be. It is all very well to say that conduits should be more deeply sunk to avoid rust marks, but many of these patent partitions cannot be cut to any depth without destroying the structure.

I agree with "Megohm" that non-metallic conduits will never entirely replace steel conduits, or, at least, not until contractors and others fully realise the implications of the impedance factor in steel conduit installations, to which serious attention is now being directed.

Undoubtedly there are many, probably the majority, of engineers who have the greatest faith in steel conduit, but has not their complacency been just the *tiniest* bit shaken by your recent articles on "Impedance of Earth Continuity Conductors" (10/6/54 and 12/8/54), which imply that impedance may be many times the measured resistance? Does not "Megohm" see any connection between this factor and the growing proportion of fires caused by persistent earth leakage, and to which attention has been directed by the Factory Department?

I would assure "Megohm" that I read his column with the greatest interest, and if my comments appeared in any way discourteous I am very sorry; I should, however, like to see his comments on any possible relation between conduit impedance and fire causation at some time.

T. C. Gilbert,
FOLKESTONE, KENT.

Dabbling

AS one who has bitter knowledge of this subject, may I state my opinion, and so join the chorus of your other correspondents.

I regard dabbling as an innocent pastime so long as it remains a hobby, and does not develop into a casual and untaxed source of income. Probably the most versatile, and incurable, of living dabblers is Sir Winston Churchill, but he does it for his own satisfaction, and he does not pretend to be superior or even equal to those bricklayers, artists, writers, etc., who do these things professionally. The usual electrical dabbler is not so modest either in his claims or his activities.

Much as I dislike controls and compulsion, I feel that something of the sort will become necessary to restrain those dangerous dabblers who, not content with experimenting on their own electrical installations, offer their spare-time services to friends and neighbours, at a cost ridiculously below that of the taxed, rated and generally oppressed professional electrical contractor.

However, it is good to hear varied views on this old and thorny subject, especially from Mr Ballard. But he need not regard himself as a "humble" electrician. After all, Michael Faraday and Lord Kelvin were content to be known as electricians.

W. A. Gazard, A.M.I.E.E.,
STECHFORD, BIRMINGHAM.

Socket-Outlets and Fixed Appliances

IT has been my opinion for some time that it is unwise, unnecessary and bad practice to permit the installation of socket-outlets in bathrooms. A fixed appliance, which appears to be the only kind sanctioned in bathrooms, does not need a socket; a ceiling rose if of adequate rating, a joint box or a fused tee box, is much more suitable and probably cheaper. I would go further and prohibit the supply of any fixed appliance from a socket outlet, with the possible exception of lighting fittings requiring lowering for cleaning. Why reduce the reliability of the earth continuity path by fitting a useless plug?

I can, however, see some wisdom in Regulation 201 D, which limits the load of fixed appliances on a ring circuit to 50% of the circuit rating; but only where the circuit supplies a mixture of fixed and portable appliances. I feel that the regulation should be amended to permit a ring or plain circuit to supply a 100% load of fixed appliances up to 30 A rating, to facilitate the installation of electric heating systems, such as tubular heaters.

I am interested in "Megohm's" little difference of opinion with the protagonist of flexible non-metallic conduits. I share the former's view that the system has its applications, but they are by no means universal. In the past when I have had jobs which seemed suitable for the system I have been disappointed to find that the range of non-metallic boxes available was extremely limited. It seems rather indecent to suggest that the reputed virtues of all insulated systems should be sacrified by such an intimate association with steel boxes and all their alleged vices, all because manufacturers have not been enterprising enough to look beyond competitive housing work and provide such elementary necessities as non-metallic small circular conduit boxes with spouts similar to those of B.S.S. 31 and switch-boxes to B.S.S. 1299 dimensions.

Ronald Croft,
GOUROCK, RENFREWSHIRE.

Wiring Rules Interpretations

A CHECK LIST OF SUBJECTS COVERED IN I.E.E. STATEMENTS

THE interpretations of the I.E.E. Wiring Regulations which have been issued by the I.E.E. Wiring Regulations Committee, and summarised in our pages in the past two issues, constitute the second set of such interpretations, a previous set having been issued in 1952. To facilitate the task of determining whether relevant interpretations exist when queries arise on the twelfth edition of the Regulations, we give below an index of the interpretations, listed against the number of the Regulations concerned.

Queries on the meaning of Wiring Regulations should normally be addressed to the Institution of Electrical Engineers. Summaries of the interpretations noted below were given in the ELECTRICAL TIMES on 24th July, 1952, and 5th and 12th August, 1954.

Since the twelfth edition of the Regulations was published in May, 1950, a supplement has been issued (1954) altering the wording of several regulations and modifying some tables, and a temporary relaxation (1952) has changed the current rating of cables in certain circumstances.

REGULATION	SUBJECT OF INTERPRETATION
2	Methods of securing covers over live terminals.
	Fittings wire and p.v.c. cords not for extra l.v. circuits.
	Cable sizes for motor circuits.
101, 102, 103, 106, 107	Control of domestic installation by separate main switches
115	Medium voltage inside fluorescent fittings using l.v. lamps.
201	Common neutral conductors on sub-circuits.
	Definition of fixed apparatus and mode of connection to ring.
	Dual socket-outlets.
	Socket-outlet adaptors on ring circuit.
	Bunching conductors at fuseway.
	Clarification of fixed and portable apparatus—electric panel fire.
	Inter-connection of spurs from ring circuit.
	Fused plug and socket-outlets on d.c. ring.
	Supplying clock from ring circuits.
	Diversity factor with regard to domestic appliances.
	Looping conductors in fuseway on distribution board.
	Connection of ring to existing cable run.
202	Fittings wire and p.v.c. cords not for extra l.v. circuits.
	Fuse ratings of sub-circuits.
	Bunching conductors at fuseway.
	Looping conductors in fuseway on distribution board.
203	Fusing of pilot lamp circuits.
205	3-plate wiring system with ceiling rose.
209	Clock connectors and a.c. socket outlets.
301	250 V grade cables on 3-phase 3-wire 440 V systems.
303	Fuse ratings of sub-circuits.
309, 310	Use of red wires in switch drops.
311	Use of red wires in switch drops.
	Differences between flexible cable and flexible cords.
313	Looping conductors in fuseway on distribution board.
	Bunching conductors at fuseway.
315	Running of main and circuit cables in same conduit.
	Running of power and lighting in same conduit.
	Running of power and lighting with telecommunications cables in steel ducts.
	400 V 3-phase and 230 V 1-phase in same conduit.

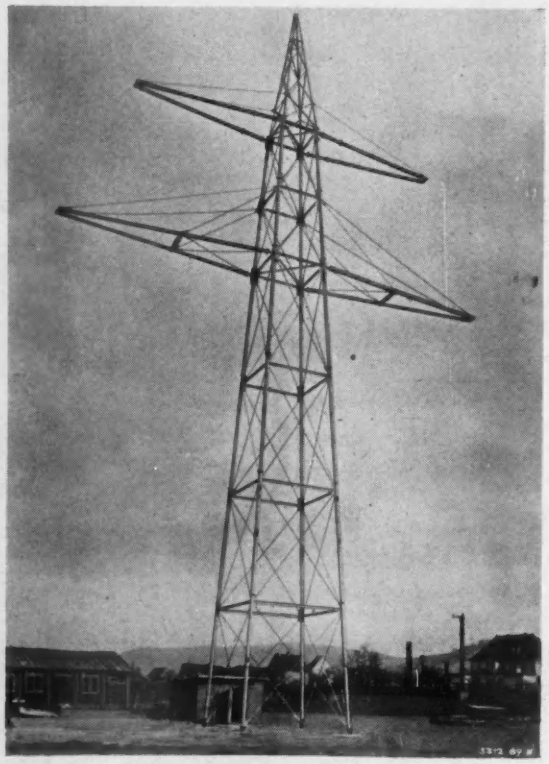
REGULATION	SUBJECT OF INTERPRETATION
403	Spacing of gas pipes and electrical cables.
	Survey of earth continuity impedance testing and general earthing.
404	Wiring of bakelite ceiling roses.
	Spacing of gas pipes and electrical cables.
	Distance between gas taps and electrical socket-outlets.
	P.V.C. and t.r.s. in cavity walls.
	Running p.v.c. and t.r.s. under floorboards in slotted joists.
405	Installations using concrete ducts.
	Spacing of gas pipes and electrical cables.
	Distance between gas taps and electrical socket-outlets.
	Survey of earth continuity impedance testing and general earthing.
406	Installations using concrete ducts.
408	Spacing of gas pipes and electrical cables.
	Distance between gas taps and electrical socket-outlets.
	Survey of earth continuity impedance testing and general earthing.
409	Spacing of gas pipes and electrical cables.
	Distance between gas taps and electrical socket-outlets.
411	400 V 3-phase and 230 V 1-phase in same conduit.
	T.R.S. cable in buildings for surface wiring.
	250 V grade cables on 3-phase 3-wire 440 V systems.
412	Earthing of transformer secondary circuits of 15 V or less.
413	Clock connectors and a.c. socket outlets.
	Use of fittings wire and p.v.c. cords not for extra l.v. circuits.
	Spacing of gas pipes and electrical cables.
	Distance between gas taps and electrical socket-outlets.
606	Fusing of pilot lamp circuits.
612	400 V 3-phase and 230 V 1-phase in same conduit.
614	Wiring domestic equipment in damp locations.
615	Earthing of transformer secondary circuits of 15 V or less.
703	Push stop buttons for motors.
704	Cable sizes for motor circuits.
709, 710, 715	Earthing of transformer secondary circuits of 15 V or less.
716	Clock connectors and a.c. socket-outlets.
	Operating clock from existing 15-amp socket-outlet.
803	Medium voltage inside fluorescent fitting using l.v. lamps.

Regulation	Subject of Interpretation
805	Switch rating for supplying gas discharge lamps.
807	Rating of sub-circuit with incandescent or discharge lamps.
817	Medium voltage inside fluorescent fitting using l.v. lamps.
1001	Earthed metal boxes on non-metallic conduit runs.
	Fittings wire and p.v.c. cords not for extra l.v. circuits.
	Earthing brackets supporting all insulated outside fittings.
	Earthing metal switch boxes.
	Earthing of transformer secondary circuits of 15 V or less.
1002	Use of socket outlets in bathroom for supply fixed apparatus.
	Socket outlets in bathrooms.
1003	Dimensions of earth lead and earth continuity conductor.
	Survey of earth continuity impedance testing and general earthing.
1004	Dimensions of earth lead and earth continuity conductor.
1005	Survey of earth continuity impedance testing and general earthing.
1008	Dimensions of earth lead and earth continuity conductor.
1106	Survey of earth continuity impedance testing and general earthing.
1107	Procedure for measuring resistance of earth electrode.
1301	3-plate wiring system with ceiling rose.
	Control of electric fire circuits.
	Backless consumers service unit not to Regulations.
	Switch rating for supply gas discharge lamps.
	Earthing of transformer secondary circuits of 15 V or less.
1303	Backless consumers service unit not to Regulations.
1306	Fittings wire and p.v.c. cords not for extra l.v. circuits.
1311	Differences between flexible cable and flexible cords.
1312	Clock connectors and a.c. socket-outlets.
1315	Methods of securing covers over live terminals.

Unusual Transmission Tower Design

Use of tubes lined with spun concrete

DUE to the shortage of steel in Western Europe, immediately following the war, investigations were pushed ahead to develop a structure for transmission towers which would be strong and light, yet would use the minimum amount of steel. Attention was naturally paid to the use of steel tubes, although some fifteen years ago experiments in Germany using tubular lattice towers had been abortive due to water finding its way inside the tubes and setting up corrosion. After 1945, towers were used in Italy and Austria with corner members of angle iron, while the diagonals were of thin walled steel tubes. Although these were lighter than the conventional structure, the price per tower was much the same although savings were made in transport and erection costs. A few years ago, the Swiss revived the idea of tubular lattice towers, but with the interior of the corner members filled with concrete as a precaution against buckling and as an anticorrosion measure. In pursuance of this idea, concrete was prepared on the ground and carried to the top of the tower, being then dropped down the corner members and compacted with vibrators. This method was scarcely satisfactory, as was found in practice.



Tower for 220 kV made of tubes lined with spun concrete

The problem was then further investigated by Siemens-Schuckertwerke Aktiengesellschaft, who concluded that the use of spun concrete within the tubes, allied to suitable tower design would be satisfactory. The process of spinning the concrete into the tubes is remarkably simple and is effected (after welding on the flanges or angle-plates) in a machine similar to a lathe with a variable speed drive. A predetermined quantity of plastic concrete, prepared in accordance with instructions, is fed into the tube which lies at an angle of about 30 degrees. After spinning, the water pressed out of the concrete is drained off leaving behind a solid concrete with a low water/cement factor.

As a general rule, steel tubes with spun concrete lining can carry a greater buckling load than other sections under similar conditions, which makes them particularly suited for corner members where buckling is the critical factor. A tower design has been developed by Siemens using this technique and it is claimed that the aggregate supply, erection and transport costs of the towers are considerably lower than with other types.

around the trade

by Peregrin

IT seems to fall to my lot to look every trade gift horse in the mouth, and I am at it again. My ungrateful scrutiny this time is directed to the newly-regained freedom of hire purchase. For some time the daily Press has depicted two queues of interested people. On the one hand a long line of frustrated buyers, all straining at the leash, eager to embark on an orgy of spending as soon as the restrictions were abolished. On the other hand a vast assembly of fretful retailers, with hands outstretched to the glittering fortune almost within their grasp. This has not turned out to be a true picture, at least in the electrical trade.

There has not yet been a mad rush to buy, and, curiously enough, there has not been the expected demand for the lowest possible deposit and the longest possible hiring period. As with most restrictions, people have become so used to them that they are easily persuaded to continue them, and so they could be if common sense prevailed.

But common sense is not prevailing in some quarters, which is why the ordinary electrical retailer is not rejoicing at this new freedom. As one of them explained to me, when the restrictions were in force everyone had to fall into line and competition in hire purchase facilities was virtually ended. A customer could not wander round seeking the best terms, for, with certain exceptions, such as cookers, the rule was not less than a third deposit and not longer than eighteen months to pay.

Now we are getting back to the old foolish days of absurdly small deposits or no deposit at all, and one to four years' credit. This means that the small and medium retailers cannot compete, for they cannot afford to carry their own hire-purchase on uneconomical terms, while if they place their business with a finance company they must, of course, adhere to the standard terms offered.

Meanwhile, the large stores and the electricity boards are attracting credit customers by offering unnecessarily generous terms, on the principle that as they get the trade profit on the goods sold they can afford to make nothing or even lose on the hire purchase financing.

Many retailers feel that hire-purchase was quite sound and not unduly oppressed by the late restrictions. They think the Government should have left well alone. I could dwell on this at length, but as I let myself go on the subject last month, not knowing, of course, that a change was imminent, I will leave it at that.

Installation Maintenance

The old topic of domestic installation maintenance is in the news again, and it seems to be a permanent bee in the crowded bonnet of Mr H. W. Swann, who should know something about the subject. It seems to be one of those good ideas that nobody wants, and it is not difficult to understand why. By the irony of things the electrical contractor can usually obtain the maintenance of installations which do not need any—the new ones, but those crying out for urgent care and attention—the old ones, belong to owners who see no need for such fussiness.

The wiring has given no trouble for twenty years, so why get worried about it now. Even if the flexes are all moulting and become as rigid as the conduit above them, and the switches are hanging loose from the walls, the lights still work and that's all that matters.

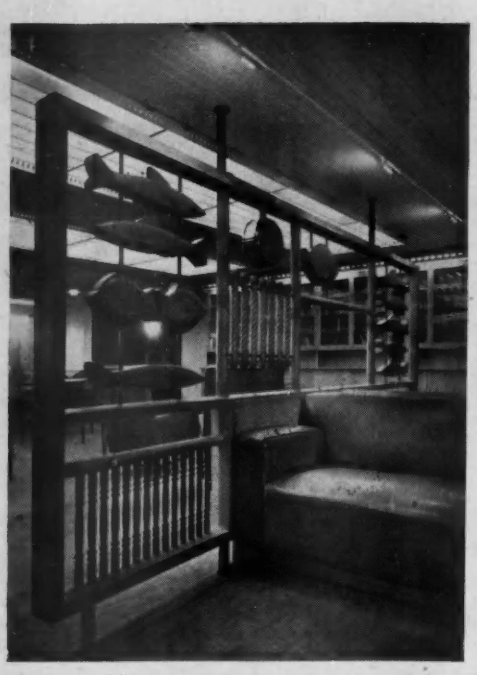
This may be a defeatist attitude but it is unfortunately true, and there is another irritating aspect to it that every electrical contractor knows. If he undertakes the maintenance of an old installation, where does he begin? The fixed maintenance charge would not allow him to start from scratch by changing the fuseboards, flexes and lampholders, refixing switches, and most likely replacing old 2-pin switchplugs by 3-pin. He would have to make a charge for all that before his maintenance contract could operate, and then the owner may decide to leave well alone and give up the idea of further maintenance until obvious need arose. It has happened.

With respect to the future the answer is for the electrical contractor to seek a maintenance contract for all his new jobs, and it would be a satisfactory arrangement for himself and his customer, but that does not solve the problem of the old installation. Can it be solved, except by compulsion? It may have to be faced some day, for there are thousands of old wiring jobs just managing to survive, just keeping above the danger mark if not disturbed. It is a contractor's dream to gather in some of that lovely unlimited jobbing work that he could fit in to suit his own convenience, and a wholesaler's paradise to supply all those thousands of bread and butter accessories, in a steady stream for years and years. Is it a dream, or are householders, landlords, shop-keepers and estate agents eagerly waiting for the electrical trade to display its customary enterprise in an unaccustomed direction?

Cookers on View

Some time ago I rashly asserted that cookers were not much of a selling line with contractors and retailers, but I soon gleaned evidence enough to make me retract. I return to the subject because I have only just become aware of the present vast choice in this relatively unglamorous appliance. I am told that at least fourteen large manufacturers regard cookers as a major part of their production, and among them they offer something like sixty types and sizes, at prices ranging from about £7 for the handy breakfast cooker to £150 or more for a really imposing creation.

But the retailer and contractor must stock cookers to sell them. One or two models to be seen are worth dozens of lavishly illustrated catalogues. It is not practicable to stock one of every model and make, but quite a modest display will lure the interested enquirer into seeking further information. When that stage is reached, the retailer has all the resources of his wholesaler at his disposal, and he can confidently take his prospective customer along to choose for himself. Yes, retailers should make a pet of the electric cooker, and they need not hasten to make hay while the sun of demand shines.



Lighting in the S.S. "Orsova"

The Metrovick lighting on the Orient liner "Orsova" uses only 4 ft and 2 ft 20 W tubular fluorescent lamps, which with only a few exceptions operate on instant-start circuits. Above are shown, top left, fluorescent lighting in the library, with bottom left, the method of lighting curtains. Reading from top to bottom on the right, we have first, the Verandah Bar, then a view of the cornice lighting in the first-class lounge, and last, cornice lighting in the first-class dining room. The fittings are designed so that both sizes of lamps can be used side by side, the cross section of both fittings being identical. The two sizes of lamp were chosen to enable fittings to be placed end to end with a minimum break in the line of light. Lamps having bi-pin caps and lampholders are suitable for this purpose as it is not necessary to overlap them to avoid black spots which are bound to occur opposite the ends of lamps with bayonet catch fittings when used in the indirect lighting of cornices. Consideration was also given to the use of the same backplate for a unit mounted in, say, an indirectly lit cornice and one fixed to a bulkhead

INDUSTRIAL MAINTENANCE

A special monthly section of the Electrical Times

Commissioning and Testing POWER TRANSFORMERS

By a Steelworks Electrical Engineer

ALTHOUGH the amount of commissioning and testing work which is carried out by works electrical staffs will vary according to the tvpe of organisation and its technical resources, some testing is bound to be required. In the present article earlier comments on cables and switch and control gear are extended to apply to transformers.

Being a static piece of apparatus the transformer is inherently a most reliable piece of electrical equipment; some care, however, is needed when a unit is put in service for the first time, particularly if it is to operate in parallel with other transformers.

The first check will be made whilst the transformer is being installed, to ensure that the connections on the primary and secondary sides are correctly made to the appropriately marked terminals. Transformers manufactured to BS 171 : 1936 are so arranged that physically opposite terminals on the h.v. and l.v. sides correspond to the same phases, and are marked A_1, A_2, etc., on the h.v. side and a_1, a_2, etc., on the l.v. side. Thus if terminals A_2 B_2 and C_2 are connected respectively to the R, Y and B lines of the h.v. supply,then terminals a_2 b_2 and c_2 will correspond to R, Y and B on the l.v. side. Transformers manufactured to the 1927 edition of the same British Standard are arranged so that the phases correspond for the alphabetical order of letters on either side; physically opposite terminals on the h.v. and l.v. sides do not necessarily correspond, and if transformers manufactured before 1936 are being dealt with this point should be noted. More will be said about phasing later.

Before the transformer is put into service oil samples should be taken from the drain valve of the tank and from any other part in which there is an oil system separate from the main tank, e.g. tap changer, diverter switch chambers. The samples should be tested for dielectric strength in accordance with BS 148. If the oil breaks down under test the only conclusion that can be safely drawn is that the sample is contaminated; this may be due either to the oil in the tank being defective or to the introduction of some contaminant during the sampling procedure. In order to avoid false results due to the latter the sampling bottles should be carefully cleaned, dried and washed out with clean oil before samples are taken; the drain valve should be cleaned before running off the oil, and in the case of the main tank it is desirable to run off a few pints before filling the sample bottles. At least three samples should be tried before reaching the conclusion that the oil is defective because such a decision will involve time and money either in the site purification or in the renewal of the oil. A rough site check to determine whether the oil is free from water can be made by inserting a heated wire into a sample of the oil; if water is present a definite crackle will be heard. It is not necessary to check the oil of a new transformer for acidity.

A construction consisting of a plain tank with cooling tubes is not adequate for transformers of about 5 MVA or larger, and in these cases the cooling system will include radiators mounted on the tank or on separate A frames, and connected to the main tank through valves. The venting of the tank, radiators and associated headers should be checked to ensure that no air is trapped in the oil system. An air lock occurred in the oil system of a 20 MVA transformer which resulted in its appearing to be full when in fact a further 220 gallons was required to bring the oil up to its correct level.

The smaller sizes of transformers are not fitted with on-load tap changers, and will usually be protected by simple i.t.d.m. relays, for which the commissioning procedure will be similar to that described earlier. When the protective gear has been proved the oil level should be checked and insulation tests taken of the h.v. and l.v. windings; it will usually be possible to do no more than check the insulation of each side to earth, unless all six ends of the windings are brought out, in which case the phase-to-phase insulation may be read. If an off-circuit tap changer is fitted it should be set to the appropriate tap and the unit may now be energised. The secondary voltages between all terminals should be read, and an audible check of the transformer may be made; excessive noise will be an indication that the core or windings are not securely clamped.

Transformer Protective Gear

Large transformers justify the use of more elaborate protective gear than that previously described, and this will frequently include circulating current or opposed voltage protection using some form of biased relay in an arrangement such as that of Fig. 1. Simple Merz Price relays cannot be used with transformers fitted with tap changers because the ratio of primary to secondary c.t. current is not constant unless the c.t.'s themselves are also tapped, an arrangement which is inconvenient and not commonly employed; the biased relays are insensitive to small discrepancies in the ratio of the currents, but are sensitive enough to operate in the event of an internal fault on the transformer. It will be seen from Fig. 1 that whilst the main windings are connected in delta on the primary side and star on the

This article is part 2 of the series "Commissioning and Testing Plant" which commenced in "Industrial Maintenance" of 24 June, 1954.

secondary, the c.t. windings are respectively connected star and delta; this ensures that the 30° phase shift between the currents in the main primary and secondary windings is not reproduced in the c.t. secondary circuits and that the c.t. currents on both sides will be in phase. Further, the ratios must be chosen so that the current to produce 5 amps in the c.t. secondary on one side will produce $5/\sqrt{3}$ or 2·89 amps in the c.t. secondary on the other side; this will result in the line currents being 5 amps in both cases.

A protective scheme of this type cannot easily be checked artificially either by primary or secondary injection, and the simplest solution is to ensure that the c.t.'s are correctly connected and then check the relay currents when the main circuit is on load. The scheme will obviously not function correctly if one of the c.t. connections is reversed and a convenient way of checking this is by connecting a d.c. voltmeter with a full scale deflection of a few volts across the secondary winding, and passing d.c. through the primary from a small dry cell such as a torch battery. This kick test is shown in Fig. 2; if the battery and voltmeter are connected as shown the voltmeter should kick positively when the battery circuit is made, and negatively when it is broken. When the transformer is energised it may be found that the relays at both ends will operate to clear the switches as soon as load is picked up; whilst this may indicate a fault in the transformer it is more likely that the pilot wires are crossed, causing mal-operation of the protective gear. The current in the pilots should be checked, and when they are correctly connected this should not exceed a few milliamps for full load on the main circuit. If the relays at one end only operate, or if reversal of the pilots will not correct the condition, the defect will probably lie in the c.t. circuits. The currents in each c.t. secondary should be checked and if these are in order the wiring and connections of the relays should be tested; if no defect shows up the only other possibility is that the meshing of the delta-connected c.t. secondaries is incorrect, resulting in the current being 60° out of phase with that from the star connected group, instead of in phase as required. A fault of this type can be rectified only by altering the connections of the c.t.'s themselves.

Auxiliary Protective Gear

Buchholz relays are commonly fitted to transformers above about 1,000 kVA capacity, and provide a form of protection which, by detecting the presence of gas in the transformer, anticipates the advent of a major fault. The relay may be tested by simply emptying the float chamber of oil and checking that the contacts actuate the appropriate trip or alarm circuits, but this will not check the operation of the lower float which should respond to sudden surges of gas in the system. A more suitable method of testing is to release some compressed air into the relay through the lower test cock provided for this purpose; this will check that the float is free and that the switch is functioning satisfactorily. Even after a large transformer has been correctly vented it is not uncommon for the Buchholz relay to fill with air when the unit is switched on for the first time,

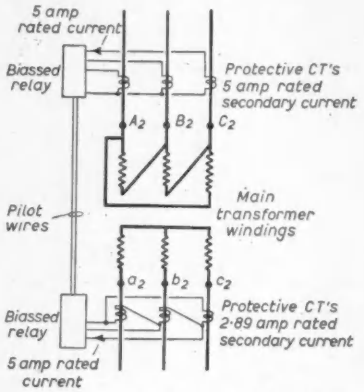


Fig. 1. Arrangement of c.t.s protecting a transformer

due to the presence of small air bubbles trapped in the windings, which are not disturbed until the unit is on load. In some cases it is the manufacturer's erection practice to connect a vacuum pump to the top of the conservator for a few hours before the transformer is energised, to guarantee that the oil system is free from air bubbles; even after this precaution the Buchholz relay may still fill with air.

It is modern practice to fit oil temperature thermometers to transformers above about 2 MVA capacity, and for the larger sizes, above 10 MVA, winding temperature thermometers are also fitted. The thermometer elements are best checked by comparing their readings with a standard thermometer when both bulbs are immersed in a vessel of liquid. The winding temperature thermometer is usually arranged to read the temperature of a thermal model of the transformer; the model is heated by current from a c.t. on the main transformer connections and its characteristics are such that the temperature it attains is that of the "hot-spot" of the winding. The accuracy of the model may be assumed when commissioning, and it will be necessary only to check the current in the c.t. circuit.

On-Load Tap Changers

Various designs of on-load tap changer are in use at the present time, differing both in mechanical layout and in the method of making the electrical transition from tap to tap. The following features are, however, common to most types:

(1) A selector switch which connects the appropriate tapping.

(2) A diverter switch which effects the transition from tap to tap. On small tap changers this may be combined with (1) above.

(3) Driving arrangements which may include a flywheel or geneva wheel to ensure that the selector switch will not be left between two taps, limit switches to prevent over-winding in either direction and "step-by-step" arrangements so that the tap changer will not continue to operate if the control switch is inadvertently left on.

(4) Alternative manual and electrical local and remote operating facilities.

The tap changer must be tested before the main transformer is energised and in the first case the mechanical operation should be checked by manually operating the gear throughout its range; the adjustment of the diverter switches should be checked, and as mentioned earlier, samples of the oil should be taken from the switch chambers. The gear should be left on the middle tap, and after the insulation resistance of the control wiring has been taken, the electrical control of the tap changer may be checked. The "raise" and "lower" limit switches should be manually operated and an attempt made to operate the gear. When the limits have been proved satisfactorily the gear should be run through its range on electrical control, and attempts made to overwind the tap changer or to leave it in mid-tap. If automatic voltage regulating equipment is included the control relay will be fed from the secondary side of the transformer either directly or via a v.t., de-

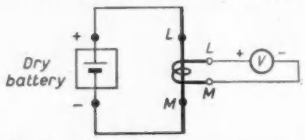


Fig. 2. Kick test. Voltmeter V will show L positive with respect to M when the battery connection is made

pending on the secondary voltage. The relay should be checked before the transformer is energised by injecting a suitable voltage across the "dead" side of the control fuses. After the transformer has been made alive and before any load is picked up the tap changer should again run through its range and the transformation ratio checked for each tap. Finally, when load current is being carried, the operation of the tap changer may be checked once more.

Phasing out—single transformers

If two transformers are to operate with both primary and secondary windings in parallel their voltage ratios, percentage impedances and phase relationships must be the same. The cable connections made on site will of course affect the phasing and unless there is definitely no possibility that the transformer will ever be paralleled with another unit, either deliberately or inadvertently, the phasing should always be checked. In the case of single transformer installations it will be necessary only to check that the phase rotation is correct.

Transformer connections may be arranged so that the voltage vector on the l.v. side is displaced relative to its h.v. counterpart by 0°, 180°, +30° or −30° in the conventional direction of vector

rotation. With convention established by BS 171 : 1936 the vectors may be regarded as the hands of a clock in which the red phase l.v. vector points respectively to 0, 6, 11 or 1 o'clock. Transformers designed to be operated in either of the first two groups cannot, without rebuilding, be arranged to operate in parallel with either of the second two types; as will be shown later it is, however, possible to re-arrange connections so that transformers within each of the two groups may be paralleled.

If the transformer being commissioned is an isolated unit at the time of commissioning, the phase relationships can only be checked by making alive and taking voltage readings across the winding. Fig. 3 shows the nominal connections of a 6,600/440 V Dy 1 transformer, i.e., delta/star, −30° phase displacement, as an illustration of the method of testing. It is required to establish that the phase rotation at the l.v. busbars is in the order R′ Y′ B′, and that the l.v. voltage vectors are displaced by −30° from the corresponding h.v. vectors; both points must be checked because it is possible to connect the transformer so that the phase rotation is correct but the phase displacement is not. A simple test using a phase rotation meter on the l.v. busbars will not, therefore, suffice.

Readings cannot be taken directly from the 6·6 kV side, and voltages must therefore be read between the terminals a b and c on the secondary side of the v.t. and some convenient point on the l.v. side which will usually be the busbars R′ Y′ B′ and N′. There must obviously be a common connection between the two systems in order to get a voltmeter reading and in this case it will be provided by the earthed Y phase of the v.t. and the earthed neutral of the transformer secondary. At the risk of labouring the point the necessity for this common connection is emphasised; responsible engineers have been known to produce the most mystifying results through neglecting to check this matter.

Reverting to the illustration, in a practical case voltmeter readings were obtained as below with the transformer alive:

(*a*) Between v.t. terminals a b and c—110 V: in all cases.

(*b*) Between l.v. busbars: 250 V phase/neutral 440 V phase/phase: in all cases.

(*c*) Between v.t. terminals and l.v. busbars, as shown immediately below.

The vector diagram may now be constructed by drawing first the v.t. voltage R Y and B with the R vector in the reference, 12 o'clock, position; since the phase/phase voltage is 110, the voltage star will be contained in a circle of $110/\sqrt{3} = 63{\cdot}5$ V radius. The end of the Y vector is at earth potential and so is the transformer neutral which means that the two points will be coincident on the diagram. With centre N′ and radius 250 V a circle may now be drawn, and the intersections of this and arcs struck from the R and B vectors in accordance with the values given in Table 1 will determine the positions of R′ Y′ and B′. From the diagram it will be seen that the rotation is correct and that the phase displacement is −30°. This method of phasing out depends on the v.t. being correctly connected.

V.T. Terminals	L.V. busbars			
	R′	Y′	B′	N′
a	225	358	220	110
b	248	250	250	0
c	325	325	140	110

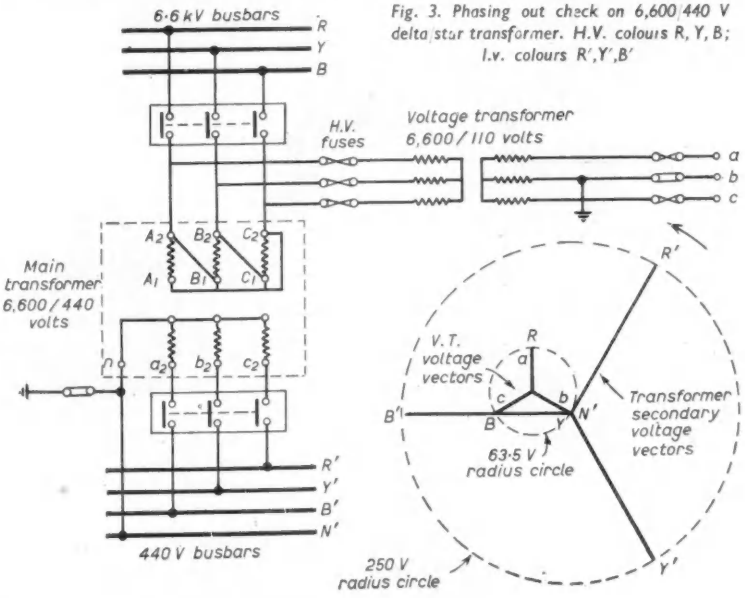


Fig. 3. Phasing out check on 6,600/440 V delta/star transformer. H.V. colours R, Y, B; l.v. colours R′, Y′, B′

Phasing out—two transformers

In cases when a transformer being commissioned is to operate in parallel with a unit whose phasing has previously been proved correct, the phasing out procedure reduces itself to a simple check of voltages between the secondaries of the two transformers. In the example shown in Fig. 4, unit No. 1 is a delta/star transformer which has been correctly connected to give a phase shift of +30°. Unit No. 2 is a similar transformer under test which is to be run in parallel with

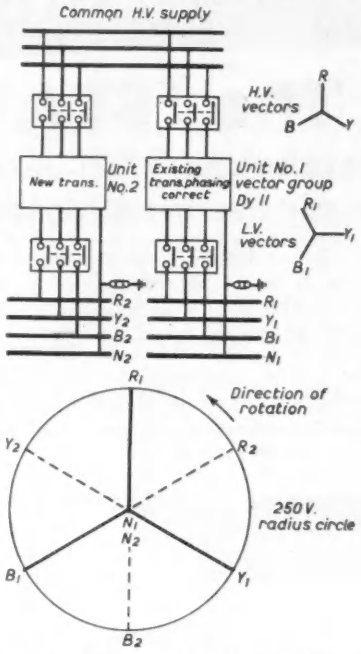


Fig. 4. Phasing out a delta/star transformer with a unit in service

No. 1. In a practical case with both neutrals earthed the following readings were obtained:

(*a*) Unit No. 1—440 V between phases; 250 V phase/neutral in all cases;

(*b*) Unit No. 2—440 V between phases, 250 V phase/neutral in all cases;

(*c*) Across busbars, as given below.

Unit No. 2 busbars	Unit No. 1 busbars			
	R_1	Y_1	B_1	N_1
R_2	250	248	503	250
Y_2	248	500	251	250
B_2	498	250	252	250
N_2	250	250	250	0

The vector diagram may be constructed by drawing a circle of radius 250 V, the centre of which will represent both earthed neutrals N_1 and N_2. The voltage vectors for both transformers will reach the circumference of the circle, and if the phasing of No. 2 is correct, the corresponding phase vectors will be coincident. In fact it will be seen that the R_2 vector is −60° out of phase with R_1, and the phase rotation is incorrect. The interchanging of two connections on the l.v. side would make the phase rotation right, but cannot correct the phase displacement. The fault lies in crossed connections to the primary side of the transformer, and in the actual case it was necessary to break down the h.v. cable box and reconnect the cores.

(*To be concluded*)

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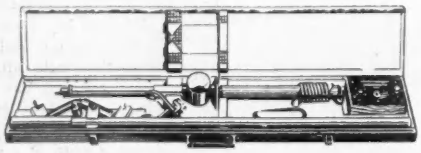

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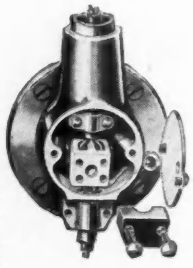


The Connection Box in the base simplifies both installation and maintenance.

For wall, bench, ceiling, floor or for mounting direct on machines, as well as portable types. Some with entries for screwed conduit, others with rubber sleeve and clamp for supply cable as illustrated.

With pillar or short vertical pivot. Various lengths of arm (maximum horizontal reach 54 in.). Six sizes of reflector.

Catalogue sent free on request.

MEK-ELEK Engineering Ltd.
17, Western Road, Mitcham, Surrey
Telephone: MITcham 3072 Cables: Mekelek, London

M.E.M. Autoline Direct-on-Line Starter

DATA SHEET 8

THE Midland Electric Manufacturing Co.'s Autoline starter has been produced to meet the need for a heavy duty direct-on-line starter of a high engineering standard to protect motors up to 15 h.p. at 550 V. The neat pressed steel case follows the modern trend of design, combining utility with elegance, ease of fixing and adequate space for wiring. The starter as illustrated is supplied in four types, with either two or three overload relays. The skeleton interior is also suitable for incorporating in control panels and machine tools.

Construction

The steel housing has four fixing holes, the top two being keyhole pattern, and provision is made for 10 alternative entries each with double knock-outs for $\frac{3}{4}$ or 1 in. conduit. All terminals are on the front of the starter.

The mechanism is mounted on a steel, rust-proof, back plate, secured with 3 captive screws. On this back plate is mounted:

(1) The contactor with horizontally operating armature.
(2) The three separate overload units.
(3) The start switch.
(4) The stop/reset bar operated by a stirrup in the lid.

Contactor Unit

This consists of a moulding A (Fig. 1) carrying the fixed silver contacts (B and E) of generous size with single screw fixing. The middle of the moulding has four square holes through which pass extended moulded bosses fixed to a moving magnet. These bosses carry the moving contacts D also of silver and spring loaded, each retained by a simple and ingenious device permitting contact replacement without any tools. The second pair of moving contacts from the left (maintainer contacts) is of a similar size and serves the coil circuit.

On either side of the moving contact assembly is a circular recess (C) in the main moulding, carrying the compression springs which return the armature to the off position. The top magnet which carries the moving contacts moves on two steel balls having little friction. The lower self-aligning magnet rocks on trunnions.

These trunnions are carried by two side frames (N), spot welded to the back plate and the side frames also locate the lower self-aligning magnet together with the traction coil. The connections to the various fixed contacts and to the coil are made behind the main moulding (A) and are covered by an insulated plate. The magnet is fully floating.

This particular starter differs from many others by having a separate trip in each phase. Each overload release operates independently of the other releases, thus giving a closer degree of protection against single phasing. They are set to trip (within permissible limits) with 25% overload, but varying degrees of protection can be obtained by choice of suitable heaters.

Each heater and trip is a complete unit. The trip units are fixed to a channel frame (L) mounted on the back plate. One unit is shown in detail in Fig. 2. The

Heaters for Autoline Starters.

Heater No.	*Motor Amps.*	*Heater No.*	*Motor Amps.*
H.14	1·92	H.28	7·55
H.15	2·12	H.29	8·31
H.16	2·34	H.30	9·14
H.17	2·58	H.31	10·1
H.18	2·85	H.32	11·2
H.19	3·14	H.33	12·4
H.20	3·46	H.34	13·7
H.21	3·81	H.35	15·1
H.22	4·20	H.36	16·7
H.23	4·63	H.37	18·4
H.24	5·10	H.38	20·3
H.25	5·66	H.39	22·4
H.26	6·23	H.40	24·7
H.27	6·86		

Standard ratings are from $1\frac{1}{2}$ *to* 15 *h.p.,* 2 *to* 25 *amps. Trip amps are* 125% *motor amps. Lower rated heaters are available.*

When ordering starter, select heater rating nearest to motor manufacturer's rating and quote heater number. Spare coils are available as noted below. Spare contacts are available in packs of eight fixed and four moving.

200/250 V Coil No. 81 (Red).
340/380 V Coil No. 80 (Blue)
380/440 V Coil No. 79 (Green)
440/500 V Coil No. 94 (Black)

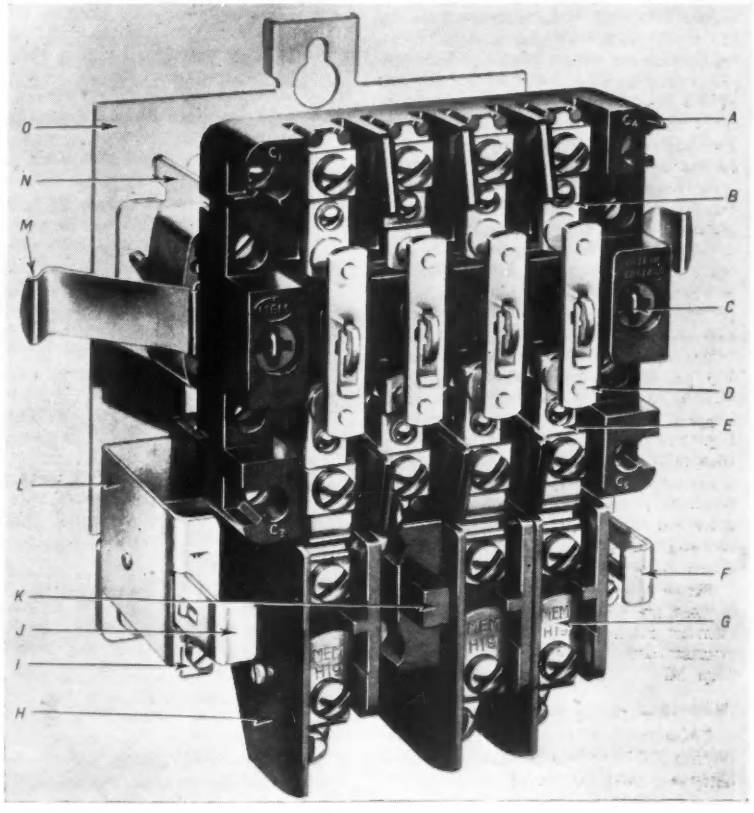


Fig. 1. Internal view of starter with one shield removed. A, main moulding. B, fixed contacts. C, return spring for armature. D, moving contacts. E, fixed contacts. F, trigger to depress trip bar. G, heater unit. I, stop to convert auto to manual. J, as F. K, start switch. L, frame. M, arc shield clip. N, frame. O, backplate.

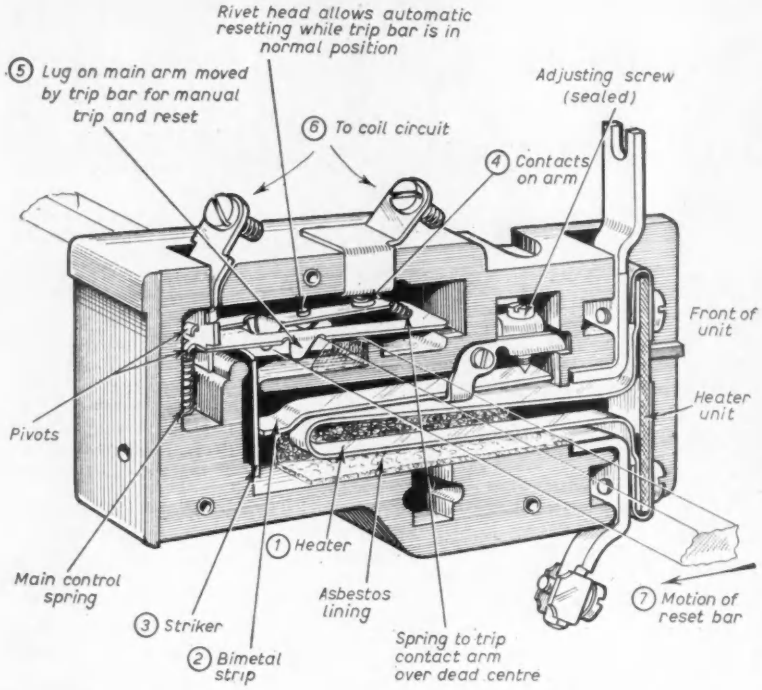

Rivet head allows automatic resetting while trip bar is in normal position
(5) Lug on main arm moved by trip bar for manual trip and reset
(6) To coil circuit
Adjusting screw (sealed)
(4) Contacts on arm
Front of unit
Heater unit
Pivots
(1) Heater
Main control spring
Asbestos lining
(7) Motion of reset bar
(3) Striker
(2) Bimetal strip
Spring to trip contact arm over dead centre

Fig. 2. Details of individual starter unit. With reset bar in position 2 (Fig. 3) rivet head engages bar for automatic resetting

heater unit 1 and G, clearly marked for rating on the front, is held in position by two captive screws and the heater strip projects in an asbestos-lined cell with a bimetal strip (2), immediately above it. Movement of the bimetal strip on overload raises the striker plate (3) and trips the contact arm (4) over the dead centre of the main arm (5). The actual switch is of the quick make and break type. Two coil circuit terminals (6) are mounted on the top of the moulding.

A long stop/reset bar (7) passing through all the three overload units is indicated in the drawing by an outline.

Fig. 3 shows diagrammatically the operation of this stop/reset bar and its position relative to the trip contacts for (1) Manual reset; (2) Auto reset; (3) For stop and reset.

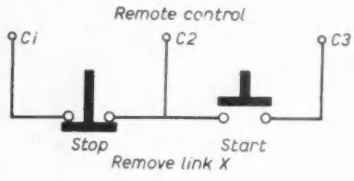
The stop/reset bar is moved by a stirrup in the lid, operated by the reset button, the stirrup pressing on two steel triggers F and J. It will be seen from Fig. 3 that the position of rest of the stop/reset bar determines whether it is auto or manually controlled and this position is governed by stops I fixed to each end of the frame L which are unscrewed and rotated 90° to suit the condition demanded. This is shown in Fig. 4.

Between the first and second trip units is fixed the starting switch K. A porcelain arc barrier not illustrated covers the contacts and is held in position by two clips M.

Maintenance

These starters are so designed in conformity with modern practice, that maintenance is extemely simple and apart from the obvious injunction to keep them clean, merely consists in replacing worn or damaged parts. The moving contacts are retained by simple catches and need no tools to remove.

1. *To change coil.* Remove the starter from the housing. The coil will be found mounted on the fixed magnet by a spring



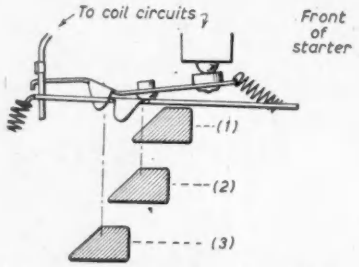
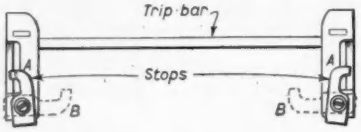


Fig. 3, above, shows possible reset bar positions : 1, manual; 2, auto: 3, stop and reset. Below, Fig. 4, shows setting for A, auto and B, manual reset.

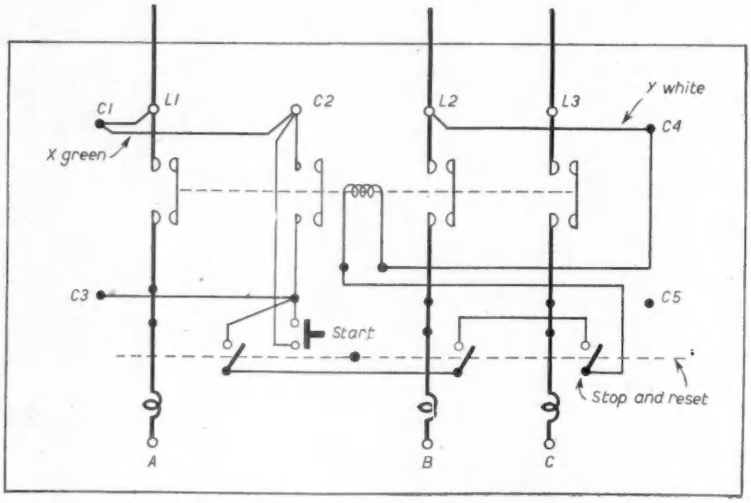


clip and is reached from the back of the starter and is held in position by a metal strip slotted at one end for easy removal. Detach coil connections, slacken the two captive screws and swing the retaining strip out of the way. The lower magnet and coil assembly can now be removed and the coil slipped off its retainer.

2. *To change overload unit.* Slacken large terminal screws E in the fixed contacts and disconnect p.v.c. lead on maintainer contact above the start switch. Remove steel cover plate on the right side of frame L. Withdraw bar. This is marked "top" at this end. Each overload unit is fixed by one screw on the bottom of the plate. Undo the appropriate screw, disconnect any p.v.c. leads joined to the trip contacts and lift out overload unit.

On reassembly, care is needed in rethreading the trip bar.

Fig. 5. Below is the starter circuit diagram, to the left the connections for remote control. For simple pilot or two-wire control, remove link X (underside of base) and connect remote switch to C1 and C3. For single-phase supply, connect lines to L1 and L2 and motor to A and B. For coil phase to neutral, remove link Y (underside of base) and connect neutral to C4



BOILERS and the Law

by S. D. Scorer, A.M.I.Mech.E.

THE steam boilers in any power station are subject to governmental supervision by virtue of Section 103 of the Factories Act, 1937, relating to electrical stations. The Section stipulates that the Act applies to any premises in which persons are employed or in connection with the processes or operations of generating . . . electrical energy. Consequently not only the steam boilers in what are normally called factories, but also commercial power stations must comply with the requirements of Section 29 of the Act.

In this Section a steam boiler is defined as any closed vessel in which for any purpose steam is generated under pressure greater than atmospheric pressure, and includes any economiser used to heat water being fed to any such vessel, and any superheater used for heating steam. By definition, it would also include any steam-heated evaporator used to produce distilled water for boiler make-up purposes.

The various sub-sections of Section 29 have been very carefully drafted, and are intended to cover the whole field of boiler safety. For example, it is stipulated that every part of every steam boiler shall be of good construction, sound material, adequate strength, and free from patent defect. This puts the onus fairly and squarely upon the shoulders of the person or corporate body responsible under the Act. Moreover, when a well-designed and constructed boiler has been installed, it and all its fittings and attachments must be properly maintained.

Regular Inspection

To ensure that any deterioration in a steam boiler is noted before it reaches a dangerous stage the boiler and all its fittings and attachments must be thoroughly examined by a competent person at least once in every period of fourteen months, and also after any extensive repairs. Thus even a boiler which has not been used for some months must be thoroughly examined again, before it is put into service, if the fourteen months currency of the previous certificate has expired.

In characteristic British fashion, no formal definition of a "competent person" has been attempted, and that person might well be an employee of the person or corporate body owning the boiler. This method, however, has rather obvious disadvantages in the event of an accident involving official intervention, as there is always the suspicion that an employee could be coerced into making statements which may or may not be quite true. Consequently practically all boiler examinations intended to satisfy Section 29 of the Act are made by competent persons employed by independent companies specialising in boiler inspection work.

Nor is the extent of the thorough examination left to individual interpretation. It must consist of an examination of the boiler when cold and when the interior and exterior have been prepared in the prescribed manner, as set out in the Notes on the reverse side of the prescribed Form 55. Furthermore, except in the case of an economiser or superheater, the "boiler" must be examined when under normal steam pressure. At this working examination the competent person must see that the safety valve is so adjusted as to prevent the boiler being worked at a pressure greater than the maximum permissible working pressure.

Check on Reports

If the Chief Inspector of Factories is not satisfied with the competency of the person employed to make the thorough examination or with the thoroughness of the examination, he can order a re-examination by his nominee. In certain circumstances the "occupier" has to pay for the cost of the re-examination. If the person about whom the Chief Inspector is doubtful is found to have made a false statement, or if the chief engineer of a boiler-inspecting company is found to have permitted a false statement, they are liable to a fine not exceeding £50.

To ensure that the result of the thorough examination is available to all concerned it must, within 28 days of the completion of the examination, be entered in or attached to the general register of the factory in question. Also, to ensure that the authorities are made aware of what is happening to the boiler, a copy of any thorough examination report in which the maximum permissible working pressure is reduced, or repairs are required, must be sent to the Factory Inspector for the district. He, in turn, writes to or visits the factory affected, and satisfies himself that the conditions of certification have been observed. To assist him in identifying the boiler in question a plate bearing an easily visible and distinctive number must be attached to each boiler when two or more boilers are installed.

Safety Appliances

The above remarks summarise what might be termed the administrative sub-sections of Section 29 whereby the person or corporate body responsible for a steam boiler must perform certain duties or submit to legal sanctions. The other sub-sections deal with the provision and use of appliances intended automatically to safeguard a boiler from explosion or other accident.

It is obvious that the pressure inside a boiler must be known at all times and must be restricted to a value less than the maximum permissible working pressure entered on the Form 55. The first is effected by stipulating that each steam boiler must be provided with a correct steam pressure gauge, calibrated in pounds per square inch, and marked in a distinctive colour at the maximum permissible working pressure. The word "correct" implies that the gauge must be periodically tested for accuracy, and in practice one test per year is acceptable.

The second requirement is met by fitting a safety valve set to blow at the maximum permissible working pressure and having a diameter sufficient to prevent an increase above that pressure under any conditions. (In actual practice an accumulation of pressure of up to 10 per cent is permissible with all steam and feed valves closed and the boiler being fully fired).

Provision must also be made to ensure that the water level is always above a pre-determined safe value and that attention is immediately drawn to any departure from the normal. To comply with this sub-section at least one water gauge of transparent material or other approved type must be fitted. Moreover, unless a boiler is externally fired (for legal purposes all water-tube boiler types appear to be classified as *internally* fired) it must have a fusible plug or an efficient low-water alarm device. In practice the requirement is usually met by providing a float or similar form of appliance which, under low water conditions, operates a whistle or alarm bell.

Steam pipes and receivers are no more invulnerable with respect to failure than other types of pressure vessel and in certain circumstances it would be possible for the boiler contents to be ejected through a burst main. Section 29 therefore stipulates that a stop valve should connect the boiler to the steam pipe, the underlying principle being that the valve can be closed before serious damage is done to the boiler through the ensuing low-water conditions. It will be noted that in many water-tube boilers this requirement is assumed to be met when the stop valve is located on the steam-main side of the superheater. Presumably the official view in this application is that the superheater is part of the boiler

An amplification of the stop-valve requirement is that when a boiler is one of a range of boilers in continuous use,

means must be provided to allow the boiler stop valve to be relieved of steam pressure (by a blank flange or isolating valve between it and the steam main) so that the valve can be dismantled and thoroughly examined.

The principle of isolation is also applied to safeguard personnel inside the boiler when it is shut down and opened for cleaning or maintenance while other boilers to which it is connected are still in service. It is thus illegal for anyone to enter an empty boiler unless all hot water or steam inlets are disconnected from the range, or the valves or taps controlling such entry are closed and securely locked. Where a boiler has a blow-off pipe in common with one or more boilers, or delivers into a common sump, the blow-off valve or tap on each boiler must be made so that only one key can be used for all the blow-off valves and cannot be removed while the blow-off valve into which it is fitted is open.

Penalties and Investigations

Prosecutions for failure to carry out the requirements of Section 29 of the Factories Act, 1937, usually fall on corporate bodies rather than on individual persons. The Boiler Explosions Acts, however, empower the authorities to apportion individual responsibility and financial penalties in the event of an accident to a boiler.

In the Boiler Explosions Acts the word boiler means any closed vessel used for generating steam, or for heating water, or for heating other liquids, or into which steam is admitted for heating, steaming, boiling, or other similar purposes. It thus covers everything under steam pressure, in a power factory, from the main steam boilers to the smallest steam trap.

Under these Acts the authorities can investigate the causes of a boiler explosion (which may be any occurrence from a tube perforation to the rupture of a steam drum) and can cause the individual or individuals held to be liable for the explosion to pay the costs of the inquiry. The authorities are not concerned whether Section 29 of the Factories Act, 1937, has been flouted but with the person or persons responsible for causing the explosion. When all reasonable precautions have been taken, Parliament provides for the costs. When otherwise, the administrative as well as the technical staff of a generating station may be held liable. Nevertheless, a prosecution under Section 29 might well follow upon the results of the Boiler Explosions Acts Inquiry.

CAN WE IMPROVE

Equipment Labels

asks E.C.

THE design of electrical equipment and installations is steadily improving, but the way they are labelled usually leaves much to be desired. By labels, I mean any written matter, such as the circuit designation, "on," "off," type and serial number, and so on. Too often, labels are just stuck on as an afterthought and no matter how much effort has gone into the design of the equipment, its value and appearance can be ruined by inadequate labels.

Poor Labels

One famous switchgear manufacturer supplies panels with white enamel labels which have large black letters of irregular shapes and spacing, giving a cheap and nasty impression to first class gear. (He should study the lettering used by London Transport.) However, in one recent instance, these labels were hidden away behind voltage transformers on each panel and could only be seen by using a ladder. The same manufacturer fits brass labels on each panel, giving the details of type, serial number, protective devices, etc., which can be seen with difficulty only when the circuit breaker is racked out. On another make of gear, no "on" and "off" labels are provided and those unfamiliar with the gear have to study the interlocks to decide whether the switch is closed or not. Surely this matter deserves a little more attention, especially on export orders, where the gear may very likely be compared with stylish American or Continental products.

Improvisation

In many industrial plants and electrical installations, very few labels are supplied initially, and the plant gradually acquires a crop of labels and notices, chalked, pencilled, stamped on metal, typed and framed, or marked with hieroglyphic symbols. This is obviously inefficient and even dangerous in emergencies, but I think the main cause of the trouble is the difficulty the average plant engineer has in obtaining suitable labels, and if a manufacturer could market a clear and durable type of label fairly cheaply it would have a very large sale. Perhaps there is some such type available; if so, the author would be very pleased to hear of it.

At present, unless the plant is large enough to possess its own metal engraving machine, the only methods of obtaining suitable labels are:—

(*a*) Order enamelled iron or engraved metal or plastic labels. These labels are expensive and take too much time and trouble to obtain.

(*b*) Make metal foil labels on railway station machines. These labels have a limited application, but are useful for stores.

(*c*) Type cards and encase in transparent plastic sheet. These are only suitable for temporary use.

(*d*) Paint or stencil labels on the equipment. This is expensive in labour and maintenance costs.

Ideal Arrangement

The ideal arrangement is to be able to make labels on site as required, without expensive machinery. For instance, would it be possible for moulded or stamped plastic letters of various sizes and colours to be supplied, which could be assembled on a plastic base to form the required wording and then pressed into position in a vice? Or letters could be printed on individual plastic squares which could be assembled and sandwiched between two layers of transparent plastic after purchase. Or does any reader know if there is already an answer to this problem?

Cable Breakdown

THE letter of your correspondent, J. E. Hooper, published in the May *Industrial Maintenance* Section, in which he describes his experience of failure in a m.i.c.c. cable, prompts me to pass on a recent failure, with a slightly different installation using m.i.c.c. cables.

The installation comprises a 3-phase 415 V supply to a h.r.c. fused switch, p.i.l.c.s.w.a. cable to an oil-immersed slip-ring resistance starter, and single core m.i.c.c. cables between starter and an 80 b.h.p. wound rotor induction motor.

The motor had been in normal use when a maintenance man while cleaning the plant room noticed what he referred to as "a hole in the copper cable." The motor was immediately put out of service.

It was found that one of the m.i.c.c. cable conductors to the stator had become very hot, the insulation had fused under the heat, and the outer sheath had melted. The heat must have been considerable because two of the single core m.i.c.c. cables to the rotor had also melted sheaths where in juxtaposition to the faulty stator cable, although the conductors were sound. The maintenance log book revealed that one of the h.r.c. fuses in the fused switch had ruptured three weeks previously and had been replaced, but there was no other action or testing.

Careful enquiries pointed to a similar finding as J. E. Hooper had elucidated, namely a very high inductive voltage in the No Volt coil of the starter, when the coil circuit current was interrupted as the stop button was operated. A voltage surge suppressor has already been fitted to the starter, the faulty cables replaced, and no further trouble experienced.

These cases of m.i.c.c. breakdown would seem to call for some action on the part of starter manufacturers, for whilst a characteristic of m.i.c.c. cable is positive breakdown with high voltage surges, other types of cable also must be subjected to the same voltages, which I imagine must shorten the cable life.—*Ronald W. Marsh.*

Some Points about the Electricity Regulations

Part 7

By H. W. SWANN, O.B.E., D.F.H., M.I.E.E.

ALTHOUGH maintenance attracts so much attention in the organisation of a works' electrical department, the Electricity (Factories Act) Special Regulations 1908 and 1944 devote little space to it. It is used in its widest meaning only in Regulation 1 which requires, effectively, that "things shall be so *maintained* as to prevent danger, if reasonably possible." Some aspects of this requirement were being discussed at the end of the last article in this series, with special reference to the organisation of maintenance.

Records are fundamental in any system, but technical staff are relieved of much paper work by a records office which reminds chargemen and shift electricians of the plant due for attention each week, and provides the supervisory engineers with an up-to-date report of its condition.

The routine in one large plant where 6,000 motors are running falls into three main catergories:

(1) Daily or weekly inspections for cleanliness, lubrication and operating conditions.

(2) A more detailed examination of plant when stationary, including control and protective gear.

(3) Periodic testing and overhaul including dismantling where necessary, changing of switch oil, examination of bearings and other jobs intended to ensure satisfactory running until the next periodic attention.

The scheme also seeks to concentrate on breakdowns both as regards their cause and frequency and also to learn something from each which may go towards knowing how to prevent it.

(Grateful acknowledgments are made to Mr G. N. Hewett, Messrs McLellan and Partners).

Pocket size maintenance handbooks have been prepared which afford guidance for the periodic examination and testing and also serve to remind the personnel of the daily, weekly and other items of the ordered routine. Charts have been drawn up also on which technical staff can mark off the jobs done leaving the record clerks to enter up, classify and report where it is necessary for action to be initiated.

Schemes of this character are in use in a large number of factories and where some central organisation, such as consultants, or the headquarters of a large industrial concern, is capable of comparing reports, much can be learned about the incidence of particular troubles and the relative success of the maintenance staffs in preventing their recurrence.

From time to time, usually after the occurrence of an accident, I have had to examine specific jobs of maintenance work in some detail in order to understand what had to be done and the method adopted. The fact that an accident had occurred usually meant that somebody had worked on, or near, live conductors either by intention or by mistake. Whilst the necessity of working on live equipment is usually much less apparent after an accident than before, there are a great many cases where the maintenance man must see a thing work in order to find out whether it is all right and if not what is the matter with it. In a handbook I have seen which deals with the kind of troubles met in servicing contactors, travel limit switches, interlocks and such like, this fact is taken into account. The electrician is told that if he has to find the cause of a particular case of stoppage he should first look at the fuses or circuit-breaker and if they are in order, make sure that the current is reaching the control unit by holding in one of the direction contactors and momentarily pushing in the main contactor. If an arc is drawn on releasing it the presence of current is indicated. It is added that this operation is best done by using two pieces of dry wood so as to avoid shock.

Trial and Repair

Apart from the fact that the job could possibly be done with a pocket type live line detector, this handbook does supplement my own ideas about the extent to which work on live gear is regarded as unavoidable in practice. When looking at the legal position in connection with such work, which enjoins that danger shall be prevented so far as is reasonably practicable, I have tried to distinguish between examination or trial of equipment and the repair work which may follow. If there is a breakdown or stoppage somebody has to find out what has gone wrong before it can be put right but when the latter involves pushing a screw driver into a live double pole switchbox with close unshielded centres, or using a spanner on a live circuit-breaker, I think the tolerance of this broadminded regulation is being somewhat strained. This view seems to be supported in the same handbook which advises that the main switch should be opened before the cover is removed from an interlocking relay which trial has shown to be defective.

The distinction between operational trial and manual repair does however become difficult if the former happens to involve an accident, because the occurrence of the latter implies that danger was not prevented. It is not easy to determine the legal position in all of these cases because danger may have been unnecessarily incurred and the opinion of one engineer as to what constitutes a safe job may be widely different from that of another. If a man has done a particular job in the same way for ten years without an accident it is perhaps unreasonable to say it was dangerous because he slips up in the next year but it might be unwise to put another man on to the job without first going over it carefully in the light of the conditions disclosed by the accident.

Detailed investigation of accidents does in fact disclose wide variation in individual methods of maintenance and although technical training schemes are excellent, and handbooks invaluable, they can hardly hope to cover the innumerable details which make up the job and thus we come back—as always—to the personal factors which is probably the hardest thing of all to evaluate or anticipate. It was for this reason that the annual issues of the Departmental publication *"Electrical Accidents"* always contain fairly detailed accounts of how accidents have happened and maintenance engineers should find them of personal interest even if the stories are always about somebody else.

Earth Leakage

As industrial installations get older the importance of testing increases and more engineers are now taking the view that it should include earth leakage indication or recording. Preference is shown for instruments working with ring type transformers, through which either the phase conductors or the connection between neutral and earth, are taken to form the primary. These transformers are so designed that the secondary current is limited to a safe value for the instrument without regard to the magnitude of the primary current, which is a considerable advantage because it enables the instrument scale to be open at the lower values around one ampere.

In substations, where the connection between the neutral and earth is usually accessible, it can be passed through the ring without much bother, but if it is desired to indicate leakage by fixing an instrument near a normal service termination, taking all the main conductors through the ring, there can often be a lot of difficulty in finding room for it. In this latter method the transformer is working on the differential, or current balance, principle, and if the service is 3-phase four-wire all the conductors have to go through say a 5 inch ring, which

takes some contriving. For single-phase it is easier, as only two conductors are involved and there may be some slack lead which can be put through the ring. One manufacturer markets a split transformer of which the two-part iron core is capable of being fitted to embrace the conductors, and then bolted together, the windings being all on one side like a tong tester. Although accuracy may suffer as a result of magnetic reluctance at the joint this may not be of great importance because the value of the instrument really lies in the indication of leakage as such, and four amperes are nearly as bad as five.

Experience with Leakage

Some engineers who have fitted leakage indicators have told me of their first experiences. In the larger and older factories it is not uncommon for the ammeter to go hard over and in one case the engineer wrote to a firm of manufacturers asking them to change the 0-10 scale instrument for one to read 0-50 amp. Apropos to this it is worth remembering that leakage is recorded by the electricity meter as well as by the special indicator.

Leakage often appears to be widely distributed, and may be caused by tracking in wet processes, worn flexible threaded in the suspension chains of lighting fittings, or faults in the windings of coils or resistances in which the current is limited to less than that required to operate circuit protective devices. Several engineers have expressed surprise at the large number of intermittent faults revealed and the electricians who have to find them have formulated descriptions of earth leakage indicators which do not appear in the manufacturers' catalogues.

When I first heard these high leakage stories I used to feel surprise on learning that the places where they had occurred had not gone on fire. I have got over this now because I realise that, as in cases of electric shock, the long arm of coincidence wards off much of the danger. The leakage must be of a value less than the fuse setting, be concentrated, and flow through a point of resistance high enough to produce a hot spot at a place where there is something to catch fire and then spread it. This adds up to seven factors which have to be coincident before a call goes out to the fire brigade and perhaps my friends of The Electrical and Insurance Surveyors Society will be interested in this point of view.

I have seen records charts which show that the intermittent faults can have high momentary values and although they would be unlikely to cause hot spots they might involve sparking between conduit lines, cable sheathing and the structure—a matter of some interest to engineers in chemical works or explosives factories.

There are other forms of leakage indicators which do not involve the use of ring transformers. For instance, it used to be customary to connect lamps between each conductor and earth in otherwise fully insulated systems, the idea being that an earth fault would pull down the potential of the conductor and thus diminish the brightness of the lamp on that side. Instruments can be substituted for lamps but I have not seen devices of this character lately.

There have been other engineers, who have found on fitting leakage indicators, that there was no leakage, not even a little capacity current, and they have expressed some doubts as to whether they have had value for their money. Assuming that they have connected the indicators the right way, a point which can be checked by creating an artificial fault, I feel that they may take credit for a well-maintained installation and I hope they will not forget to give an occasional look at the indicator.

Main Switchgear

Whilst circuit-breakers and motor control equipment get a fair degree of operational use this may not always be true of the gear on the main switchboard or in works substations. I have known circuit-breaker failures to take place just because the mechanism had become stiff through disuse and failed to respond when the short circuit eventually arrived. It is becoming generally recognised that periodic overhaul is desirable with trip testing and that the latter should be by way of some form of injection current combining an operation test with calibration. Now that thermal overload protection for motors is becoming common it is easier to test and set trip gear for short circuit and earth leakage protection without having to allow for motor starting current in the time elements. Even so I think many engineers set trip gear high to guard against unwanted operation because, although a burnt-out motor explains itself to the production manager inadvertent operating of trip gear does not.

In large establishments the arrangements for power supply may include substations operated and maintained either by the Area Board or by the consumers engineer and there will be need of trip grading in terms of current and time settings. The maintenance of automatic protective devices at this level and farther back within the field of generation and transmission which is handled by the B.E.A. divisions, has become a highly specialised and responsible job. Electronic control, with monitoring supervision has been superimposed on the older forms of overcurrent and differential protection, and the accompanying picture (by courtesy of the N.W., Mersey and N. Wales Division) gives an idea of the complicated test procedure involved in maintenance, for which the justification lies in the fact that over 90% reliability has been achieved in response.

Electronic Equipment

In very large organisations, such as Government Departments, the non-technical personnel at high administrative level tend to classify an engineer by his label and assume that if he is an "electrical" man he should know about everything from power stations to electric mouse traps. A man brought up in the electric supply business must therefore not be disconcerted if he is asked to advise on say permanent waving machines, or television in cinematograph theatres, and I think some of the senior engineers who have built up extensive experience in the maintenance of the power and lighting equipment in factories must be considering whether their labels should be amplified to cover the job of looking after the electronic processes, which are becoming an established feature of industrial progress.

Some years ago when it seemed there might be a problem of this character both for maintenance engineers and factory inspectors I tried to measure it firstly by visiting manufacturers to see what they were making and then, secondly, to find a regulation or two which might apply to such specialised products. Clearly they ought to be earthed and although under certain conditions of very high frequency it appeared possible to have nodal points of potential in earth wires, that discouraging fact was not allowed undue weight. The assemblies of control equipment looked like a new edition of switchboard as defined, there were fuses, conductors, insulating material, high and low pressure systems, and other things coming within the ordinary terms of the Regulations and in the last resort the whole lot, including thermionic values, transistors, inductors, chokes and capacitors etc., could all be regarded as "apparatus" for purposes of Regulation 1. Thus the legal position was regarded as not materially different from that which has arisen from time to time throughout the long history of the Regulations when something new has arrived, and I make the point because one or two electronic engineers I have met were inclined to think they were a shade above the law. The new technique, like those of electrochemistry and others, is just another case for co-operation between manufacturers, users and inspectors each trying to learn from experience and apply the knowledge to securing a reasonable standard of safety.

Training in Electronics

This is a praiseworthy platitude and I thought I had better find out what was likely to happen to the user's maintenance staff whilst trying to learn from experience. Perhaps this process should be supplemented by some special training and I obtained invaluable advice from Mr Brasher which led me to consult Professor Moullin, Mr S. E. Godall and other members of the Institution Education Committee. Broadly speaking, the view seemed to be that although specialisation was essential to specialised production and utilisation, the experience of engineers likely to hold responsible positions in the future should be widened, and thus I found one firm of manufacturers recruiting most of their electronic men from the 50 cycle power ranks whilst another took opportunities of sending selected electronic men off to power con-

tracts for a time. The Admiralty seemed to favour the former course, but I was left with the feeling that the educational facilities available in manufacturing and service organisations did not extend to factory maintenance engineers except in so far as manufacturers installing electronic equipment under contract were able to show the customers' engineers how to look after it. A good deal has in fact been done in this latter direction by the preparation of carefully compiled handbooks, and affording facilities for customers' engineers to see electronic plant under construction, and have the working explained.

In some cases factory engineers have told me of their difficulty in deciding whether to try to take a new electronic application in their stride or to engage a specialist. A good many considerations have to be taken into account, such as the size and character of the electronics application, whether its maintenance will provide a full time job for a specialist, and if not, what else he can do. This is where the matter of the label comes in and many electrical plant engineers would feel that their managements would expect them to handle any new electrical process as a matter of course and they might not be very willing to give an impression to the contrary effect. To my mind the question turns on the conditions which obtain in each place and I think a plant engineer with a considerable staff of electrical men, able to handle the upkeep of several hundred motors with automatic control equipment, lifts, mills, welders, and such like, will regard electronic gear as just one more step along the path of industrial progress and will lead his people to learn and adopt any new technique required. But there are a great many places where two or three electricians are working under a general plant engineer and if the management puts in dielectric heating, electronic speed control, or light ray press guards, they may be at some initial disadvantage and might not be regarded as "authorised" or "competent" persons for purposes of Regulation 28 which says, in effect, that unless they are competent they must not undertake the job.

There is more in this than getting a high frequency burn because where electronic control is used for rotating machines, incorrect operation may lead to accidents involving other people. Thus there is a real problem in the smaller factories especially where the maintenance electricians are self-made and perhaps getting on in years.

I have tried, with much assistance from Mr S. E. Goodall, and the Ministry of Education, to get some classes started for maintenance electricians and electrical contractors' men who may have to service electronic equipment. The Electrical Department of the Borough Polytechnic has in fact prepared a syllabus, and opened a class in the autumn of 1953 but it was not well attended, possibly because the new facilities offered were not widely known. Thus the maintenance requirements of the smaller industrial users would at present seem to depend on the manufacturers or some other forms of outside servicing.

This picture shows a typical array of test gear used for the maintenance of B.E.A. protection equipment

I heard some views expressed on this at a meeting in December 1953 of members of the Association of Supervising Electrical Engineers on the occasion of the National Lecture by Mr A. J. Lillicrap. Although he was concerned mainly with radio and television servicing he mentioned the industrial side and this aspect was taken up by speakers closely concerned with it in practice. References were made to h.f. heating, vibration testing and electronic balancing equipment, and to the desirability of training courses for service electricians at technical institutions and at manufacturers' works. The fact which seemed to emerge was that whilst servicing of domestic radio and television receivers is wide-spread and well organised, industrial maintenance from outside is not on a large scale although some manufacturers have a number of contracts with business concerns and factories using electronic equipment. This is perhaps a little surprising in view of the lecturer's statement that "the amount of industrial equipment being sold and used these days is really staggering."

In his references to training, the lecturer said that a college course might last two or three years and even if followed by a manufacturers' course would not necessarily make a skilled service engineer for whom experience counted more than anything in the way of academic training.

Electronics in a Paper Mill

With this lecture, and the subsequent discussion, in mind I turned to some papers recently placed at my disposal by the courtesy and kindness of my friend Mr William T. Laird, who has been Chief Electrical Engineer to the Guard Bridge Paper Company, St. Andrews, for over twenty years. I visited this mill twice recently to see the large scale electronic equipment which the B.T.H. Co. Ltd., has installed for the control of the sectional paper-machine drive and on each occasion I discussed the proposals for maintenance, which were of exceptional interest both on account of the unique application and the fact that Guard Bridge is not on the manufacturer's doorstep. The two alternatives of importing a young specialist, or training two members of the existing electrical staff, were carefully weighed and as other engineers have the same problem the pros and cons may be of interest. The specialist would be ready made, and be able to train others, but there was not a full-time job for him on electronic work alone. They doubted whether they could find a man possessing also the experience and skill required to install and maintain heavy equipment or to do bench work with requisite craftmanship. This meant split responsibility

because the existing staff would have to look after the machine-driving motors, and contactor gear, leaving the electronic controls to the specialist.

They decided on the alternative of training for the following cogent reasons:

1. To employ a specialised electronic engineer would be an admission of defeat.
2. The existing staff might not like it either.
3. For better or worse they had entered the electronic field and the sooner they set about becoming "au fait" with it the better.
4. They thought it would be easier to make an electronic engineer out of a good power man than to make a good power man from a "boffin."

Two men were selected and steps taken to interest them in elementary electronics. B.T.H. films were projected and an "Emitrol" equipment (which I have seen) was purchased for controlling a one h.p. motor with which the men were encouraged to experiment by putting on faults, checking valves and thyratrons and generally getting the hang of it. Later when the main assembly was ready at the B.T.H. works the two selected men were sent there for one week and given a highly intensive course for which I have seen the carefully prepared syllabus.

In the light of over a year's subsequent running experience they are satisfied that they did the right thing, and although there have been occasional worries, there has been no serious interruption and they now they know a lot more than they did.

The paper making machine runs from midnight on Sunday until midday on the following Saturday. This allows Sunday for weekly inspection and maintenances supplementary to the daily morning check-over. The Sunday work is done to a schedule which covers examination and blowing out of motors, withdrawal and cleaning of trays carrying unit electronic assemblies, with changing any valve or thyratron seriously deteriorated.

Fault Experience

Tracing faults has been facilitated greatly by the manufacturer's list which gives the symptom, cause and remedy. They have had very little trouble and tell me that valve failure is infrequent and only three thyratrons out of sixty-four have been replaced. Valves are not taken out for routine characteristic test unless suspect. One or two capacitors have broken down, probably because the place was pretty warm, and they have had cases of bad contact on small switches and relays, which, speaking as power engineers, they think are too lightly got up for industrial use.

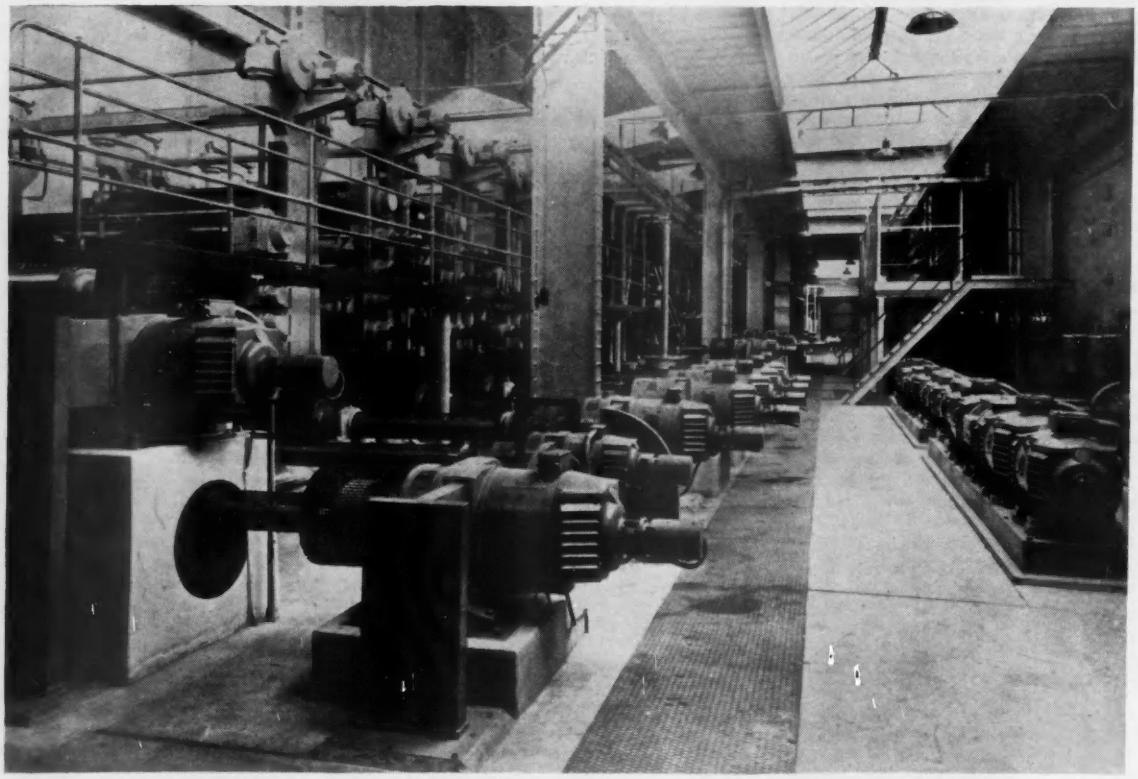
They have sometimes gone after faults which they never found because they were not there — the explanation being that when a papermaker on the machine finds something going wrong he is apt to look up at the mysterious array of panels in the control gallery with misgiving and send for the electrical people first.

The high temperature in the gallery also let them in for trouble with certain wire wound resistances which altered their critical values as a result of the formers expanding and stretching the wire. The setting of micro-gap switches, operated from a chain-driven cam, was upset by wear on the sprockets with stretch in the chain and they also had something to say about valve holders for thyratrons but they seem to have enjoyed this new kind of trouble-hunting for which they have purchased a range of special Avometers, which includes an electronic tester which imposes only a negligible load on the circuit to which it is applied and can also be used for measuring the capacity of condensers. A valve characteristic meter has also proved of great service.

I was particularly interested in their unwillingness to regard electronic maintenance as beyond them and I think that many experienced engineers, who have dealt successfully with the various innovations and changes of practice which have taken place over the last two decades, are unlikely to be put off by anything in electronics except perhaps the name.

LIVE LINE TESTING

THE live line testing equipment illustrated on page 11 of the July issue of Industrial Maintenance in the article by Mr H. W. Swann is made by Everett Edgcumbe and Co. Ltd., Colindale Works, N.W.9, and not as stated.



View of mill drive at the Guard Bridge paper mills. Electronic equipment is installed on the gallery

What are we doing with SAFETY?

Considerations of Portable Tools Voltages

by T. C. GILBERT, M.I.E.E.

THE reluctance of employers to place portable tools and equipment energised at 240 V single-phase and 415 V three-phase in the hands of their operatives has been exemplified recently in the activities of the Engineering Equipment Users Association, crystallised in the paper presented before the Utilisation Section of the I.E.E. by Mr J. W. Bunting, B.SC., A.M.I.E.E. In this, serious proposals for the general reduction of voltage for portable tools and the adoption of monitored earth-lead protective devices were examined in detail and recommendations made, all with the view of making portable and transportable gear as safe in general use as is practically possible.

Commendable as this sudden upsurge of concern is, it is perhaps a little surprising in view of the fact that although some thousands of additional portable tools must go into service each year, with increasing age of those already in use, the annual reported fatalities with portable tools remain at approximately the same level year after year. Further, about half of the reported fatalities could not have been prevented by any present proposals, as they were due to evasion of regulations, the use of appliances from lampholder plugs and two-pin sockets, or amateurish extension of the flexible connections. However, the writer would not for one moment advocate complacency in this connection, and the purpose of the present article is to examine the proposals and to ask if we are going the right way about achieving a higher degree of safety for the operative.

Voltage Drop Considerations

Proposals for reduction of voltage to 25 V are perhaps reasonable for handlamps in highly hazardous situations, but quite out of the question for portable tools; likewise, a reduction to 50 V, with mid-point earthed, would have serious disadvantages. Manufacturers recommend that portable tools should be operated within 5% of their nominal voltage, and as Mr Bunting has pointed out, with 50 V tools the permissible voltage drop would be only 2½ V, as against 12 V for the 240 V tool. In other words, to obtain the same percentage drop on 240 V and 50 V cables of the same length and transmitting the same power, the cross-sectional-area of the 50 V cable would have to be about 25 times that of the 240 V cable. It would therefore seem that there is no possibility of arranging an economical 50 V distribution system for a factory, and those people desiring to use low-voltage tools are obliged to install local transformers, with further complications.

Regarding transportable equipment, that falling outside the category of portable tools and operated by three-phase supplies at 415 V, the writer is rather perturbed to note the degree of complication proposed for the protective equipment. Looking at the economic aspect alone, some of these monitored earth-lead devices will cost about £15 each for single-phase and £20 each for three-phase applications, and each device controls only *one* piece of equipment. It is possible, perhaps certain, that expensive protective devices of this kind would be adopted in the large and well-run factory, where they are least required, but extremely doubtful if they would be seen in the smaller works in any numbers, but where the need is greater owing to the generally lower standard of installation work and maintenance and inferior training of the operatives.

The writer feels that we are in danger of losing ourselves in the maze of differing and alternative proposals now offered for securing a few more percent safety, and perhaps a little fresh air might be allowed to blow in. Surely a reasonable degree of relative safety can be achieved with the exercise of common sense, without the use of excessively complicated protective devices, which by reason of their bulk and fearsomeness alone induce a sense of ever-present danger in the minds of equipment users. To get down to rock bottom, out of the welter of personal experiences, recorded happenings and technical examinations of the past few years two main risks seem to emerge; one is, the voltage of the supply to which the victim is exposed, and the other, the length of time that he remains exposed to it. Of these two, the latter is the more important.

Before considering complicated protective equipment, it should be remembered that it is only a few years since the simple voltage-operated earth leakage circuit-breaker was described as being too complicated and delicate for general application in comparison with direct earthing. This latter method is quite capable of providing its quota of safety, given a reasonable chance to do so; if, as Mr H. W. Swann remarked at the discussion in question, proper loop tests are made, with, the writer would add, reasonably high values of testing currents and the adoption of *impedance* values in the earth loop, we should soon be made aware of the existence of conditions adverse to the successful use of direct earthing. All the time we are content to rely upon foolish little milliampere tests for merely a small section of the loop, and fiddle with resistance values as the only criterion of goodness, just so long shall we go on pressing direct earthing into service under conditions in which it cannot possibly prove effective. Given a permanently low-impedance and heavy current-carrying capacity earth fault path, with good electrodes, direct earthing can do its stuff and does in many thousands of old and new installations.

Even this apparently simple form of protection is not entirely escaping modern embellishments, however, as proposals have been noted to apply cataphoretic phenomena to earth electrodes, designed to move the earth's moisture towards the driven electrode. This is similar to cathodic drainage protection, and consists of passing about 0·5 amp. at 20 V d.c. from a fixed anode, with this current flowing through the earth to the cathodic electrode. It is recorded that by this means an initial resistance of some 26 ohms has been reduced to 16 ohms, with the expenditure of about 6 kWh; for permanent resistance reduction the process must, of course, be continuous. The writer is of the opinion that this process will prove too costly for general use, necessitating the installation of d.c. generators, transformer/rectifiers or batteries, with the maintenance of expendable anodes, not only at the consumer's electrode but also at the substation, and as 16 ohms is still far too high for all practical purposes, it is suggested that where electrodes invite this kind of attention direct earthing should be abandoned in favour of some less troublesome form of protection.

Even with effective direct earthing there must always be some liability to increase in fire risk associated with heavy fault currents flowing over exposed conductors, conduits, etc., which may be in contact with other non-electrical metal piping. Recent proposals to reduce possible fault currents to more manageable values by means of core-balance devices do not, in the writer's view, adequately meet requirements in this direction. With the blessing of regulations, such devices may operate with an out-of-balance (leakage) current of 5 amps, but should a leakage reach only 3-4 amps due to impedances then the devices remain on the threshold of operation, with the current flowing persistently. The continuous passage of 4 amps at 240 V can produce almost as much heat as a 1 kW radiator if concentrated in one spot, such as a conduit joint, and the fire risk appears to be there still. If these devices could operate with out-of-balance currents of a few milliamps that would be talking from the fire protection angle, but ultra-sensitive equipment of this kind would probably be a nuisance.

It is therefore suggested that we get back to the fundamentals previously mentioned, voltage and time, abandoning all consideration of *current*-operated protection in *any* form. In this connection the writer notes with satisfaction that at the heart of practically all the complicated monitored earth-lead and similar devices now under active consideration is the simple little voltage-operated earth leakage circuit-breaker, surrounded, however, with all kinds of additional accessories and hung round with complicated circuits. Let us just take this small heart out and have a look at its capabilities when operating on its own, without any of the proposed complications.

Earth Leakage C.B.s

It is known, of course, and has been proved by many users, that modern leakage trips installed in the proper way and with adequate check exhibit absolute reliability—hence the selection of this device for the new equipment. Test records in the writer's possession show that with 13 V across the trip coil operation takes place within 78 millisecs; with 40 V, in 17 millisecs; and with the full 240 V across the coil, and which is to be anticipated momentarily with all earth faults, operation takes place within 8 millisecs, or less than half a cycle of the supply frequency. Critics say that if the trip coil burns out, the equipment will be unearthed, but, as Mr Bunting has himself emphasised, the coil is only subjected to voltage under fault conditions for the 4 to 12 millisecs required to trip the breaker, and with 240 V applied to the coil the heat generated in this short time is only 0·5 g.cal.; after 60 operations under direct fault the temperature of the trip coil is barely perceptible. Mr Bunting has recorded experiments with standard voltage-operated trips, of the types intended for incorporation in the new devices, with operations at 80 per minute and no more than 12 V across the trip coil. At 6,500 operations one trip failed to safety, due to slight wear on a toggle preventing the mechanism staying latched in; after adjustment further operations reached 12,000. A second circuit-breaker reached a total of 7,800 operations before failing to stay latched in.

This independent record of reliability, which can be matched from other sources, including the writer's experiences, should be convincing evidence that the voltage-operated trip, shorn of all complications, is quite capable of handling the voltage/time aspect of safety all by itself, and the writer would prefer so to use it, cheerfully throwing overboard all the proposed trimmings, monitored earth leads and what-not. It will be said that without the monitored connection between the protective device and the tool a disconnection can occur without the operator's knowledge, or the earth connection may become detached from its terminal and make contact with the phase, with dire results. This is true, but surely in any well-run works portable tools make an occasional journey to the maintenance shop, where connections are checked; in some works they are checked before the tool is issued from the store, and Mr Swann has described a device whereby the operator can do this for himself. It will also be said that such tests are not simple, as they must be made with heavy currents on the earth core lest this be reduced to the few strands that represent an illusory degree of safety, but this is only true where direct earthing is relied upon for protection. It will be claimed that with the use of monitored devices this need for tool maintenance may be eliminated, but this is misleading; what will happen is, that the necessity for careful maintenance will be transferred from the tools to the protective devices themselves and it is easy to decide which is likely to be the more involved and costly. From the productivity angle it is surely better to maintain the tool or equipment.

Testing Protective Equipment

There remains the important matter of testing protective equipment, which in the writer's view is essential for reliability and must be capable of being carried out by non-technical personnel—in fact, the actual users of the equipment. Core-balance devices and certain types of the proposed monitored earth-lead devices do not make any check by means of a test key of the vulnerable main earth connection between the protective device itself and the earth electrode—at least as important from the safety aspect as the carefully monitored connection between the protective device and the tool—but one design of monitored equipment described in the paper mentioned does afford a check by test key of the *voltage* trip earth connection, leaving the main earth connection unchecked, however. As this is apparently the best that monitored devices can accomplish in the way of automatic check it must be pointed out that the simple unadorned voltage-operated trip can already do this for itself, and is therefore on a level of complete equality as regards a simple and non-technical earth connection check as the most advanced monitored devices.

The writer would summarise his points as follows:—

1. More than 50% of portable tool fatalities reported each year could not have been prevented by foresight, as they were due to evasion of regulations, the use of tools from lampholder plugs and two-pin sockets, or amateurish extension of flexible connections. The picture is therefore not quite as black as it is painted in connection with the use of portable tools at 240 V, taking into account the annual increase in the number of tools put into service and the static position of the fatality figures.
2. It is agreed, however, that every attempt must be made to reduce the accident rate, but is this likely to be more readily achieved (*a*) with the introduction of complicated and expensive protective equipment, representing theoretically a high degree of safety, but which will be too costly for use in the numbers necessary; or (*b*), with the use of simpler and cheaper devices, which although possibly less efficient individually at least stand a good chance of being installed?
3. If it be agreed—and the writer is himself convinced of this— that it is the *time* factor to which the main attention should be paid in safety considerations rather than possible contact voltages, then transformation to lower voltages would certainly appear to be the wrong way to go to work. As has been stated, the higher the contact voltage the more rapidly isolation can be effected—with 40 V in 17 millisecs., but with 240 V only 8 millisecs. It surely cannot signify if the possible contact voltage be the

higher value if isolation can be ensured within 0·01 to 0·02 second.

It will be said that a sudden shock even of this short duration may be enough to tip a man off a ladder or catwalk, but surely no more likely at 240 V than at 110 or even 50 V? In order to ensure speedy isolation against a possibly high impedance earth continuity conductor attached to a poor electrode, *voltage* is essential, but where supplies are transformed down to some lower ostensibly safer value this initial low voltage, plus the voltage drop inescapable with the higher currents involved, conditions may well result in an inadequate voltage level at the protective device for ensuring rapid isolation. The incidence of fault impedance also comes into the picture here, but is too involved a matter to be dealt with in this article; it is clear, however, that if any serious voltage drop occurs in the fault itself further complications are introduced with an initial low voltage.

Probably a more fruitful line for investigation would be in connection with greater concentration upon insulation and reinforced insulation, with tools exempted from the necessity for earthing in the same way that domestic equipment is under Reg. No. 1001 (B); tools could still be metal-clad, but with more adequate attention to insulation and spacing as described in Definitions, "Insulation, Double", would be inherently safe.

Acknowledgment

The writer acknowledges permission granted by the Institution of Electrical Engineers to refer to, and quote from, the Utilization Section papers and discussions.

NEW LITERATURE

Indian Electrical Year Book 1953-54

THE scond edition of this useful publication, which sets out to give a complete picture of the Indian electrical engineering and supply industries and to establish a medium of contact between the buyer and seller of products of electrical industries, now includes the radio and electronic field. Containing some 9,000 names and addresses, the year book is divided into sections, such as electrical supply, air-conditioning, contracting and agencies. Those sections dealing with traders are sub-divided according to geographical location and at the end a separate buyer's guide to equipment is included. Statistics, presented in cogent form, show the position of the Indian market and production since 1946. Introduced by short articles on the progress of Indian industrialisation, Indo-Foreign trade agreements, and Indian electrical and allied standards, the book should prove of great value to all concerned with this market. Published by M. Largo-Afonso, Bombay, 278 pp., 7¼ in. by 10 in.

Magnetic Amplifiers and Saturable Reactors

Edited by M. G. Say, PH.D., M.SC., M.I.E.E.

WRITTEN by a team of experts primarily for engineers dealing with control circuits, this latest book should prove of value to all concerned with control problems where magnetic amplifiers may be used. Since these components have only been available in quantity of recent years, although knowledge of their possibilities may be widely known, details of their workings and methods of application to particular problems may not be and it was with a view to providing this information that the book was written. The first chapters are devoted to the background of the subject, construction of various types is shown, the magnetic principles involved are discussed, and the various circuits theoretically described. Following a description of such applications as push-pull circuits, and theory of magnetic modulators, the last chapters are concerned with the applications of saturable reactors to control circuits and instruments. Throughout, the book is written in clear style, the mathematical treatment is readily understandable and the text liberally interspersed with diagrams and photographs. Published by George Newnes Ltd., 199 pp., 5¼ in. by 8¼ in. Price £1 1s. 0d.

Radio Engineering. Vol I. (2nd Ed.)

by E. K. Sandeman.

ALTHOUGH originally developed for maintenance engineers at B.B.C. transmitting stations, this volume is also of considerable interest to all who wish to derive a fundamental knowledge of alternating current theory and practice. It aims at giving a logical and readily understandable development of basic theory leading up to its application to the practical circuits in use today in radio receivers and transmitters. This is the second edition of the book, the first having been published in 1947, and a considerable number of minor additions have been made. Two major changes, however, are the inclusion of a section on transmission line filters, and a clear statement on the method of calculating the noise factor of a receiver. Published by Chapman and Hall, 779 pages, 5½ in. by 8¼ in. Second edition, price 60s.

Mathematics In Action

By O. G. Sutton, C.B.E., F.R.S., D.SC.

THE application of mathematical techniques to the solution of advanced or complex physical problems is scarcely a subject to appeal to the layman, yet it is of fundamental importance to civilisation as a whole. Dr Sutton, in this little volume has selected a few of the problems on which he has worked professionally from time to time, and described in simple language the mathematical attack made on them. He has also in his introductory chapters, given an interesting dissertation on the development of mathematics as "tools of the trade" as opposed to "pure" mathematics, and indicated the close relationship which must necessarily exist between them. Most science students at technical colleges and in their first year at universities, would undoubtedly profit from a reading of the book as it provides a glimpse of the fields to be conquered by the mathematical physicist. Published by C. Bell and Sons, 226 pages, 5½ in. by 8½ in. Price 16s.

BOOKS RECEIVED

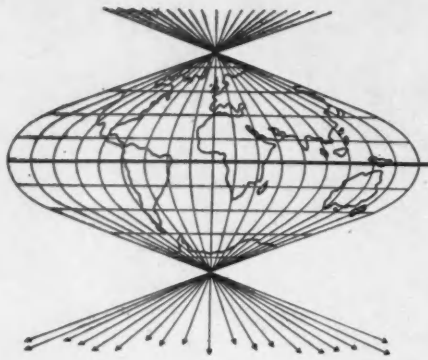
Questions and Answers on Electric Motors, edited by E. Molloy. Covers important practical details of all types of a.c. and d.c. machines, this edition dealing with speed control and starter methods. Fifth edition, published by Newnes, 120 pages, 6¼ in. by 4 in. Price 6s.

The Amplification and Distribution of Sound, by A. E Greenless. A new edition which revises and enlarges previous editions and includes later developments and other items now in more general use. Third edition, published by Chapman and Hall, 300 pages, 8¼ in. by 5½ in. Price 35s.

Clarke's Tables and Memoranda, revised and enlarged by P. Honey and W. J. Woolgar. Pocket compendium of technical data for electrical, sanitary and heating engineers, builders, plumbers and other craftsmen. Tenth edition, published by B. T. Batsford Ltd., 4 Fitzhardinge St, W.1, 400 pages, 4 in. by 2¾ in. Price 8s. 6d.

Crystal Rectifiers and Transistors, edited by M. G. Say and E. Molloy. Details, development, preparation and application of germanium and silicon on a practical basis, being part of publisher's Electrical Engineering Progress Series. Published by Newnes, 170 pages, 8½ in. by 5½ in. Price 21s.

Raw Materials for Electric Cables, by A. King, V. H. Wentworth. Comprehensive account of materials used in cable construction, giving details of sources, special forms and requirements, characteristics, operative conditions and tests in a reference book for both manufacturers and users. Published by Benn, 362 pages, 8½ in. by 5½ in. Price 42s.



OVERSEAS NEWS

A SUMMARY OF IMPORTANT EVENTS

CANADA

St. Lawrence Project Inaugurated

After years of discussion, the St. Lawrence power project was inaugurated last week at ceremonies in the U.S.A. and in Canada. The first was held at Massena, New York State, where Governor Dewey fired a dynamite charge; later the official party crossed the river to the Canadian town of Cornwall, where the Canadian Prime Minister, Mr St. Laurent turned the first sod with a silver spade. During the ceremonies, Mr Dewey said that experts held that nuclear-based energy would not compete with that provided by the St. Lawrence scheme for thirty years or more.

Tenders for the preliminary work on the power dams were called for recently. Present plans require the initial generation of power in 1958, with effective completion of the project in 1959.

Ontario's share of the St. Lawrence River power project is to be known as the Robert H. Saunders-St. Lawrence generating station. The official announcement that the name had been approved by the other two members of the Commission was made at a testimonial dinner last month honouring Mr Saunders, given by the Ontario Municipal Electrical Association. The dinner was organised to honour Mr Saunders' contribution to the successful negotiations leading to final approval for the St. Lawrence power development.

Transformer Factory at Regina

Construction of a new factory to produce transformers began recently at Regina, Saskatchewan. It will be the third transformer factory built by the Pioneer Electric Co. Transformers up to 5,000 kVA will be produced, the planned output being 4,000 transformers each year.

Foreign Competition

Canadian industry will not reduce its standards to meet competition, Mr H. H. Rogge, president of the Canadian Westinghouse Co., declared recently when commenting on the "invasion of the Canadian market by foreign heavy power equipment firms." He admitted that meeting foreign competition was one of the electrical industry's greatest problems, and suggested that they should educate the big utilities and their customers to evaluate what they were buying. The public were paying for security and continuity of service. The manufacturers intended to give it to them. He said foreign competition made the opportunities for sales negotiations unequal in view of the marked difference in wage scales paid in European and Asiatic countries in comparison with Canada. Despite this, Canadian Westinghouse was combing its own cost structure for evidence of needless spending in order to bring prices down. Mr Rogge also referred to the firm's success in obtaining an order for 12 transformers for the Bersimis development of the Quebec Hydro-Electric Commission, against stiff foreign competition. He described the Bersimis undertaking as a "calculated risk" on future cost factors which it felt justified in taking on an individual job to indicate industry was not sitting on its hands and complaining but was trying to do a job to the best of its ability.

Licence for British Columbia Power

A conditional water licence is to be issued immediately for a big power development scheme in the Atlin Lake region of northern British Columbia. This was announced by the Minister for Lands, Mr Sommers, recently. The development is to be carried out by the North West Power Industries, a subsidiary of Quebec Metallurgical Industries and Frobisher Ltd. The license will enable the company to proceed with a survey and other basic steps in the first stage of a $270 m. development project along the British Columbia-Yukon border. (See ELECTRICAL TIMES, 12 Aug).

AUSTRALIA

Loan for Victoria Power

Recent work and future plans of the State Electricity Commission of Victoria were reviewed when the Chairman of the Commission, Mr R. A. Hunt, announced a £3 m. public loan for fuel and power development. The past year's activities have included the erection of power stations at Geelong, Ballarat, Red Cliffs, Shepparton and Warrnambool, which together have added 75 MW to the State generating system. The first generator at Yallourn has been brought into service while the Melbourne City Council completed a 30 MW extension to its own Spencer St station. The rate of connecting new consumers was 25,000/year.

The works programme for 1954-55 includes completion of the first 100 MW extension at Yallourn, resumption of work on the Morwell project, which involves a power station and a briquette factory, and completion of a 62MW power station as part of the Kiewa hydro-electric project. The Kiewa and Yallourn 220 kV transmission lines to Melbourne should be completed, and supplies extended to some 27,000 new consumers.

Capricornia Extension

The Capricornia Regional Electricity Board has been authorised to supply the township of Abercorn, Queensland, which is in the area of the Wide Bay Regional Board. Announcing this, the state Minister of Mines said the Capricornia Board will be able to supply the township from an extension of a transmission line now being constructed.

EUROPE

W. German Exports

After achieving a 40% increase in exports in the first half of 1954, West German manufacturers are optimistic about the prospects for the second part of the year. Exports from January to May totalled 640 million marks, compared with 457 million marks in the same period of 1953. They accounted for 26% of the industry's total sales, against an export rate of 19% for the whole of last year. Total sales in the first five months of this year amounted to 3,074 million marks, compared with 2,521 million marks in January/May 1953. Electrical machines accounted for about one-quarter of all exports, followed in importance by cables, telecommunications, equipment, switchgear, and electrical household appliances. Sales of radio sets and recording equipment rose sharply. About two-thirds of all exports went to European buyers and the remainder to South America, Asia, Africa and North America. Buyers in the United States were reported to be increasingly interested in purchases of electronic equipment — chiefly measuring devices. The West German manufacturers declared

that foreign sales of large electrical installations were still unsatisfactory. Foreign competitors, primarily British, United States and French, could offer longer payment periods than the Germans. Payment over five years, as usually allowed by West German manufacturers, was insufficient, they claimed. The international minimum was now seven years; and some U.S. firms were reported to be offering 25 years.

West German imports of electrical goods amounted to 29,960,000 marks in the first quarter of this year, against 22,120,000 marks in the same period last year.

Another Swedish Plant

A new power station with ultimately an installed capacity of over 100 MW is to be constructed at Baalforsen on the Umea river in Northern Sweden by the Swedish Cellulose Co. Initially, two generators with a total capacity of 70 MW are to be installed and in operation by 1958, it is reported.

High Demand in Czechoslovakia

Electricity consumption in Czechoslovakia has risen by 11·9% per year over the last three years, while the rate of increase of generating plant has been only 4·3%. This has resulted in extensive power cuts being necessary, stated the Czechoslovakian Minister of Fuel recently.

Railway Electrification in Turkey

Turkey's first electric railway is at present being constructed by a French group of industrial concerns on a 24-kilometre suburban line between Istanbul and Soguksa. It is now reported that plans are being studied for the electrification of the Istanbul-Ankara and Ankara-Zonguldak lines. The estimated cost is £T. 200 m. French, German and Swiss firms are interested, and it is believed that contracts when signed will call for payment over a 10 year period with interest at 6% per annum.

EGYPT

Cairo Station Approved

It is reported from Egypt that the National Production Council at its last meeting approved the credits necessary for the erection of a power station near the iron and steel works to the south of Helwan. Total cost is estimated at over £E 2·4 m. Also approved was the expenditure of £4·7 m. for the renewal, and reinforcement of the h.t. network in Cairo. A comprehensive programme for industrial electrification is understood to be under discussion.

EL SALVADOR

Using Geothermal Power?

Like a number of other countries throughout the world, El Salvador has become interested in the possibility of using geothermal energy for providing industrial power. Salvador has two principal volcanoes—Izalco and Conchagua —both of which emit large quantities of vapour. Two engineers from Italy who are visiting the country, have recommended that an effort be made to utilise the steam emitted from Conchagua in the first instance. Negotiations have already been opened with the Italian concern at Lardarello for the erection of a single turbine at an estimated cost of $3 millions.

Lempa in Operation

The first generator at El Salvador's Lempa hydro-electric scheme was put into service recently, and a second 15,000 kW set is shortly to be installed. The River Lempa Hydro-Electric Commission earlier this year entered into contracts with two Swiss manufacturers for the supply of a third generator and water turbine. These are to be installed in 1956. The River Lempa project is situated about 58 kilometres north-east of the capital city of San Salvador.

NEW ZEALAND

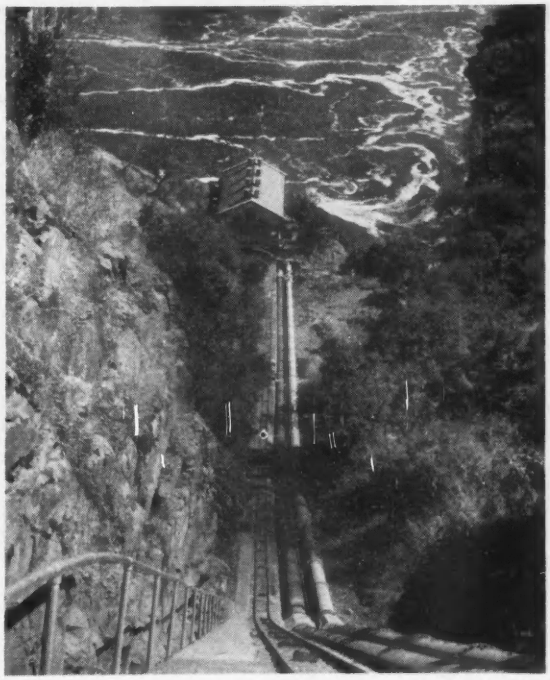
Transmission Link Completed

The Buller district on the West Coast of New Zealand's South Island is now linked with the main South Island electric power network, via Arthurs Pass, Inangahua and Waimangaroa. Power from the State Hydro-electric Department's system was recently switched through to Buller. The Minister in charge of the Department, the Hon. W. S. Goosman, said the linking of Buller with the main system marked yet another stage in the joining up of the various parts of the South Island. Later, the West Coast would also be joined to the Nelson-Marlborough system by a new line now under construction. This would make power from the new Braeburn station available to the whole of the north western section of the South Island.

Record Generation

65 m units were generated in power stations in the North Island of New Zealand during the last week of July, a new record. Total output of stations for the last complete year ending 31 Mar. was 2,600 m units.

In extensions of the Victoria Falls power station, shown alongside, a new 3,000 kW English Electric generator was recently formally commissioned by the Mayoress of Livingstone. The station as originally built by the Victoria Falls Electric Light and Power Co., contained two 1,000 kW sets supplied through a single 42 in. diameter pipeline. In 1949 the undertaking was taken over by the Government of Northern Rhodesia and the Victoria Falls Electricity Board constituted to be responsible for its operation. Extensions immediately put in hand by the Board, included the installation of a second 42 in. pipeline, and a B.E.T. 2,500 kVA transformer at the head of the gorge to step up the generating voltage of 3,300 to 20,000. A second transmission line is being erected and corresponding additions made to the step-down capacity and switchgear at Livingstone itself. Another 3,000 kW set is on order and to supply it, a third pipeline will be provided by Stewarts and Lloyds. This extension brings some difficult problems of pipeline routes and machine foundations. The existing canal is sufficient, but the forebay and settling basin must be extended and the problem of flooding taken into consideration. Consulting engineers for the project are Mackness and Shipley. Incidentally, with unlimited water in the Zambezi and the absence of any dam construction, power is developed at the Falls at an extremely low cost. We understand that the possibility of building a second power station is under consideration



Personalities

IN THE INDUSTRY

The appointment of **Mr K. L. Stretch,** M.A., A.M.INST.C.E., A.M.I.E.E., A.M.I.MECH.E., Barrister at Law, as works manager at Calder Hall, Sellafield, has been announced by the U.K. Atomic Energy Authority.

Born in Antigua, B.W.I., in 1917 and educated at Merchant Taylors School and King's College, Cambridge, Mr Stretch started his apprenticeship with Mather and Platt Ltd at Manchester. War service with the Artillery and R.E.M.E. interrupted his career until 1946 when he returned to Mather and Platt to complete his training and worked in the Research Department.

He joined I.C.I. Ltd. in 1948 as instrument manager at the Hillhouse works nr. Blackpool in the General Chemicals Division. In 1949 he became Deputy Works Engineer at Hillhouse and in Dec. 1951 was transferred to I.C.I.s Salt Division as Design Engineer where he will remain until later in the year when he takes up his new appointment.

Mr P. Blunt, B.SC.(ENG.), M.I.E.E., ASSOC.I.MECH.E., at present deputy sub-area engineer will succeed **Mr G. Faraday Davies,** M.I.E.E., whose retirement from his appointment as No. 4 Sub-Area Engineer Merseyside and North Wales Electricity Board was noted last week. Mr Blunt held engineering appointments with the Leicestershire and Warwickshire Electric Power Co., Ltd., the Mid Lincolnshire E.S. Co., and the Newport (Mon.) Corporation Electricity Department. He was mains engineer with Wolverhampton Corporation at Vesting Day and six months later became Senior assistant engineer (planning) with the Midlands Board. He assumed his present position in Nov. 1951.

Sir John Greaves has for personal reasons decided to relinquish after five years, his post as managing director of Davey Paxman and Co., Ltd., as from 30 Sept. next. He will retire from the board of the company but will remain on the board of Ruston and Hornsby Ltd.

He is to be succeeded by **Mr G. W. Bone,** M.I.MECH.E., M.AMER.S.E., assistant managing director. Sir John was Knighted in 1946. He has long associations with the sub-continent of India and was created a Companion of the Institution of Mechanical Engineers in 1947. We noted Mr Bone's appointment to the Board of Ruston and Hornsby last week.

Mr J. H. Calderwood, M.ENG., PH.D., A.M.I.E.E., lecturer in electrical engineering at the Royal Technical College, Glasgow, has been nominated as a Fulbright scholar and will sail on 28 Aug. at the invitation of Princeton University New Jersey.

At a meeting of the board of Associated Electrical Industries Ltd. held last week, **Sir George E. Bailey,** C.B.E., resigned the Chairmanship but will remain a director of the company and the **Rt. Hon. Oliver Lyttelton,** D.S.O., M.C., M.P., was elected a director of the company and Chairman of the Board.

The appointment of **Mr J. M. Fleming,** M.A., B.SC.(TECH.),M.I.E.E., as chief engineer of the Micanite and Insulators Co., Ltd., was announced last week. Mr Fleming joined the company early in 1946 as chief development engineer and subsequently became director of research. In his new position he will assume responsibility for Micanite's technical activities. His early training was received at the College of Technology, Manchester, and he returned to Manchester after his studies at Cambridge to join Metropolitan-Vickers Electrical Co., Ltd. Insulation problems were his particular study at this time and he continued with that work in America. in 1938 he joined B. S. and W. Whiteley, Ltd., and during the war was lent to Ministry of Supply as technical adviser to Mica Control. Towards the end of the war he again visited America as secretary of the U.K. Materials Mission to the United States.

Engineer-in-Charge of the new television transmitting station being built at Rowridge in the Isle of Wight is **Mr E. P. B. Metcalfe.** The station is scheduled to come into service on 12 Nov. Mr Metcalfe has been with the B.B.C. since 1936, serving as maintenance engineer in the London Control Room and at the Droitwich and Westerglen transmitting stations until 1952 when he became senior maintenance engineer at Wenvoe. Since May last year he has been engineer-in-charge at Truleigh Hill, near Brighton, but that station will close when Rowridge opens.

The N.C.B. have appointed **Mr A. Walsh,** M.B.E., LL.B.(HONS.), to be director-general of labour relations at headquarters in place of Mr Iestyn Williams, who retired last month. He is at present secretary of the N.W. Divisional Board, and takes up his new post on 1 Sept.

Two new appointments have been made to the board of directors of Cimex-Fraser Tuson Ltd. They are **Mr L. F. Walker,** who has been secretary of the company for six years, and **Mr D. C. Orders,** A.C.A., LL.B. Qualifying as a chartered accountant in 1945, Mr Orders went to Cambridge, and spent a year in the U.S. studying business administration methods there before taking a position in the City in 1950.

Mr Jack Palmer, who has been on the staff of A. C. Cossor for several years, has now joined W. H. Sanders (Electronics) Ltd., as general manager. In his new post he will be responsible for all aspects of the operation of the new factory now nearing completion on the Stevenage (Herts) industrial estate. During the war Mr Palmer was assistant works manager at Cossor's Valve Production factory at Lea Bridge, and later, after successfully weathering the acute post-war shortage of materials, became progress manager at the company's Highbury works. Prior to leaving Cossor's he was assistant chief buyer.

Mr K. L. Stretch

Mr P. Blunt

Mr J. M. Fleming

Mr Jack Palmer

Mr B. A. McNicholas

Mr J. F. B. Jackson, B.SC., A.R.I.C., F.I.M., is to join the board of A.P.V.-Paramount Ltd. shortly as director in charge of the new foundries producing castings in special steels and non-ferrous alloys. These were opened at Crawley, Sussex, early last year. Mr Jackson has relinquished his directorship of the British Steel Castings Research Association to take up this new appointment.

Mrs Thelma Webber, who has been a demonstrator with the Yorkshire Board at Sheffield for the last three years has been appointed demonstrator in the Bristol Central district of the South Western Electricity Board. Mrs Webber was second prize winner in the E.D.A. public speaking competition this year and holds the City and Guilds Domestic Science Diploma.

After many years with G. S. Peckham and Co., Ltd., **Mr D. T. Jones** is leaving at the end of next month to take up a position with Display Motors and Accessories Co., Ltd., of Stanmore. He is at present general manager at Peckham's.

We understand that **Mr E. H. Ouston** has resigned as an executive director and joint secretary of the Plessey Company and that **Mr W. F. Cross** will continue to act as secretary.

Mr B. A. McNicholas has been appointed Northern Area Sales representative for the British Victor division of E. K. Cole Ltd. and will work from the London office of the company at Vigo St.

With twenty-one years of the manufacturing and retail branches of the ciné trade, Mr McNicholas had his own business specialising in educational visual aids.

Mr H. W. Wolff, B.SC., A.M.I.E.E., A.R.I.C.S., informs us that he has resigned his appointment with Dorman and Smith Ltd, in the Research Department in order to form a new company which will manufacture miniature circuit-breakers and appertaining gear. Mr Wolff has considerable experience in this field and will assume the post of managing director of the new company whose incorporation is to be announced.

On the staff of the Southern Electricity Board at the Shaftesbury offices, **Mr J. H. Jones,** a veteran in the supply industry, has retired. Mr Jones entered the industry in 1906 when he joined Edmundson's Electricity Corporation as a pupil apprentice. After training he served successively with Edwards and Armstrong Ltd. in Bristol, the West-Wilts Electric Light and Power Co., Western Electricity Co., Ltd., and the Wessex Electricity Co. These appointments were interspersed with war service. On vesting day he joined the S.E.B. at Shaftesbury.

Mr Herbert V. Harris, managing director of Bennis Combustion has been appointed chairman of the company and **Mr Bernard W. Dawkins** has joined the board.

OBITUARY

The death occurred suddenly in London on 15 August of the **Hon. J. R. Rea,** M.A.(CANTAB.), COMP.I.E.E., Barrister-at-Law, aged 51. Mr Rea, second son of the first Baron Rea of Eskdale and heir presumptive of his brother, Lord Rea, Chief Liberal Whip in the House of Lords, was educated at Westminster, Grenoble University and Christ's College, Cambridge. He was called to the Bar of the Middle Temple in 1927, and from 1934 to 1936 held a post in the department of the Treasury Solicitor and Procurator-General. In 1936 he became secretary and legal adviser to B.E.A.M.A., which post he held until 1951. During the last war Mr Rea served in the K.R.R.C. and the Home Guard.

We learn with regret that **Mr W. J. Orange,** the English Electric Co.'s general manager for India, died of a heart attack in Calcutta on 2 Aug. He was 53. "Bill" Orange had a vast amount of experience of India, Pakistan and Burma. He joined the English Electric Co. towards the end of 1935 as general manager for India, so that his associations with that firm dated back some 19 years. Before that, however, he was Lancashire Dynamo and Crypto Ltd.'s manager for India and Burma, and his service with the L.D.C. amounted to some 17 years. In his early days he was apprenticed with them. He was well known in engineering and Government circles throughout the whole of India and Pakistan, and played a prominent part in negotiating many important contracts. His loss will be felt deeply, by the company in particular, and by all in the industry who knew him.

The death occurred last week at his home at Torquay, of **Mr Walter L. Barber,** founder and chairman of the well-known Birmingham firm of the Midland Electric Manufacturing Co., Ltd. He was 75. Although living at Torquay Mr Barber always took an active interest in the direction of his company, which he formed in 1908. At that time he had but ten employees, whereas at present M.E.M. is one of the most prominent companies in Birmingham employing some 1,500 people. The original premises were in Conybere St, but moved to Tyseley in 1937 when the concern became a public company.

In 1937 Mr Barber had to leave the Midlands for Health reasons and went to Torquay. In 1940 Mr A. Wynn became joint managing director, and on the latter's appointment as managing director in 1945, Mr Barber relinquished his position as joint managing director, continuing as chairman. To mark the fourtieth anniversary of the firm, employees with over 21 years service presented him with an illuminated album depicting the company's progress. His son, Mr W. J. Barber, is with the company and is deputy managing director.

Mr Harry Dixon, M.I.E.E., manager of the Central Sussex district of the S.E. Electricity Board until his retirement in Sept. 1949, died on 7 Aug. at Haywards Heath aged 72. Mr Dixon went to Sussex in 1926 to manage the Central Sussex Electricity Ltd., and Associated Group of Companies and played a large part in the development of electricity supply throughout the central area of the county. Before that, however, he worked in the north. He was educated at the Queen Elizabeth grammar school, Blackburn, and Baine's grammar school, Poulton-le-Fylde. He was then articled to McLennan and Co. at Blackburn, subsequently joining the Blackburn Corporation Electricity Department. Leaving Blackburn, Mr Dixon went to Motherwell and later to Brechin as manager. His next appointment was as general manager with the Scottish Electricity Undertakers. Mr Dixon will not easily be forgotten in the field of sport either. In his day he was a keen all-round sportsman, playing lacrosse, hockey, cricket and football while his abilities at golf must not be overlooked. He was also a formidable billiards player.

Mr G. J. O'Callaghan, B.COMM., F.S.A.A., H.DIP. IN ED., assistant chief accountant to the Electricity Supply Board of Eire, died in St. Laurence's Hospital, Richmond, last Friday. He joined the E.S.B. on its establishment and had been keenly associated with the organisation of its activities ever since.

Mr Alexander MacDonald, C.B.E., the managing director of the subsidiary company of Electrical and Musical Industries Ltd., in Chile since 1948, died last month in Santiago.

Mr MacDonald who was a chartered accountant by profession was from 1934 to 1940 president of the British Legion Branch in Santiago.

From 1939 to 1942 he was chairman of the British Community War Effort organisation in Santiago his service being rewarded with a C.B.E. in 1943.

The death occurred on 6 Aug. of **Mr Donald S. Cargill,** aged 53. He joined the General Electric Co., Ltd., as a Witton apprentice in 1918, and on completing his apprenticeship went to the G.E.C., Newcastle, on the sales engineering staff.

In 1930 he became associated with Claude-General Neon Lights Ltd., and was responsible for their sales in the North Eastern area. Mr Cargill came to London in 1937 as the Provincial Sales Manager to Claude-General Neon Lights and held that position until 1953 when he was appointed London Sales Manager.

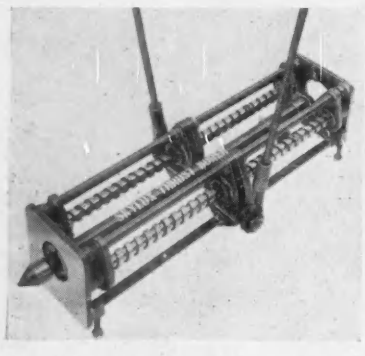
Mr Abel Crompton who retired recently after 50 years' service as an outside service engineer with the Tudor Accumulator Co., Ltd., died on 5 Aug. aged 72 years.

Mr William Blyth Archibald, of the Newcastle office of Wm. McGeoch, and Co., Ltd., died on 7 Aug. aged 63 years. Mr Archibald had represented the company in the Newcastle area for 32 years and was well known in Newcastle shipping circles.

Equipment for Industry

Thrust Borer for Cables

LAYING cables under railway tracks and canals presents special problems that might well be simplified by the application of a thrust borer, and the latest in this field is a product of S.L.X., Brunel Rd, Acton, W.3, known as the Skylux '54.' Requiring no trenching, the machine is set in a pit at the start of the cable-run and directed by means of sighting poles and level gauge to the receiving pit. Designed for operation by two men, the machine incorporates two coupled gearboxes operated by ratchet handles. The gearboxes drive lead-screws such that two crossheads move backwards and forwards in opposite directions about the centre. To commence the bore, the 46 in. long pilot tube and 3 in. diameter boring head are clamped into position and driven forward by the rear crosshead. On reaching the centre, the drive is continued by the front crosshead until the limit of traverse is reached, at which point the crossheads are in the original position and ready to receive the first 3 ft extension. An advantage of this machine over others is that no withdrawal of the crosshead is required at the end of the stroke. Housed in the pilot head of the bar is a lamp which shines down the tube and, with the aid of a gradient sighting level gives a continuous and accurate guide to the direction of the bore. Advantages claimed for the machine are an accuracy of 1 ft radius in 50 ft length of bore, and speedy operation due to the double crosshead system and, due to lack of trenching, less dislocation of traffic in congested areas. Where a bore of more than 3 in. diameter is required, enlarging heads are available which clamp to the boring bar prior to its return journey, at this stage it is usual to couple the cable and so draw it back through the bore.



Initial boring tool with pilot head is seen in position here

Water-cooled Welding Gun

NOW available in this country through the QUASI ARC CO., LTD., Bilston, Staffordshire, the "Sigma" welding process provides a suitable means of welding aluminium, stainless steel and similar metals noted for their poor weldability under normal processes. An inert gas-shielded, consumable electrode process, this system employs a water-cooled electrode gun which is stated to confer a number of advantages. It is claimed to permit a light, well-balanced construction, not only reducing operator fatigue but facilitating welding in vertical positions. Moreover, as the cooling water also provides cooling for the supply cable, a substantial reduction in the size of cable required is said to be obtained, a 50 A cable stated to be thus capable of carrying welding currents of up to 400 A, whilst minimising weight and conferring greater flexibility. Maintenance on the gun nozzle is also minimised, whilst the build-up of spatter is claimed to be eliminated. All operations are controlled from a single trigger, actuation of which initiates the flow of both water and argon together with operating the main welding contactor.

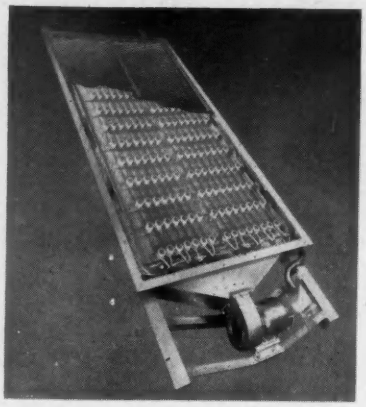
Embodying modern design features this gun has a "businesslike" appearance

A New Battery-electric Tractor

MEASURING only 5 ft 10 in. long by 3 ft 4 in. wide, a new electric tractor introduced by LANCING BAGNALL LTD., Basingstoke, Hants, known as the T.E.220, is especially suitable for use in locations where space is limited and where advantage may be taken of its excellent manoeuvrability. Propelled by Exide Ironclad batteries having a capacity of 12 kWh, the tractor is said to be capable of a normal day's work on one charge. Charging procedure is facilitated since a battery-charger has been built into the tractor. Performance figures claimed are maximum speed 7 m.p.h. and maximum sustained pull 2,000 lb Unrestricted visibility is assured for the driver since the seat is placed at the very front; provision is also made for a passenger.

Drying by Radiant Heat

DESIGNED for continuous drying of all types of material such as paper and fabrics and for drying powders and granules, a new radiant heating panel being produced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2, is especially suitable for setting nylon fabric. The radiant heating surface comprises a panel face made of glass-fibre fabric, which is heated from behind by nickel-chrome coil elements giving temperatures up to 300° C. An indicating controller connected to thermocouples fixed in the face automatically maintains the temperature at a preset value. The panel is made up of mild steel sections, which are adequately lagged to give high thermal insulation at the back, and the surface is covered with flat expanded metal. An angle-iron framework is provided to allow suspension of the panel over the material to be heated. Where an increase in the rate of heat-transfer is required, convected heat may be obtained by fitting a centrifugal fan together with air-ducting in the back and a special form of diffuser which distributes the air-flow evenly over the surface. The panels are made in sizes ranging from 2 ft by 3 ft to 4 ft by 8 ft. One measuring 6 ft by 3 ft would have a rating of the order of 20 kW.



This cutaway view of the radiant heating panel shows clearly the heating elements

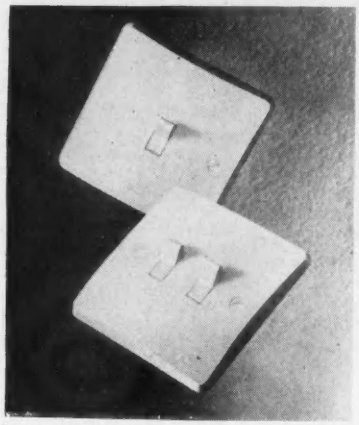
New Transductor Range

IDEALLY suitable for the control of current as employed in furnaces, electro-plating baths, dimming of lights and many similar applications, a new range of transductors being produced by STURDY ELECTRIC CO., LTD., Burnopfield, Newcastle-on-Tyne, should meet a favourable reception. Available in sizes up to 100 kVA, the normal technique of transformer manufacture is applied to their construction, having cores built up from low-loss silicon steel windings which are vacuum-impregnated and oil or air-cooling according to size.

The MK. Plateswitch for Modern Homes

NOTABLE departure from conventional switch design is evident in the "Plateswitch" developed by MK. ELECTRIC LTD., Wakefield St, Edmonton, N.8. Its simple yet distinctive contemporary styling without extravagance goes hand in hand with a robust, rigid, yet neat design. The slightly convex switch plate has well-defined bevels and round corners.

The action, smooth and positive, has been developed from the original MK. a.c. design which has been widely used in post-war installations. Moving contacts are of phosphor bronze, and fixed contacts of copper, an inlay of fine silver on the contact faces providing highest possible conductivity. The whole movement is totally enclosed and factory sealed.



Simplicity and style are noticeable in the new MK. Plateswitch

Installation time is minimised by the combination of plate and switch in an integral unit automatically compensating for irregularities on plaster depth.

Both one gang and two gang Plateswitches have 2¾ ins. fusing centres and fit into boxes to B.S. 1299. In addition a range of shallow boxes both steel and hardwood is available. The two-gang Plateswitch is made with two 2-way switches only. This, it is hoped, will simplify stocking, since either or both can be wired as 1 or 2-way switches and thus four different combinations are available. Every Plateswitch is supplied complete with four fixing screws: two for metal and two for wood boxes. In this way the range is reduced to three types only—one gang 1-way, one gang 2-way, and two gang 2-way. Each pattern is available in both brown and ivory finish. Three and four gang units are in preparation.

Competitive prices range from 31s. 4d. per dozen for the single gang one-way S.P. type 4610 in brown to 71s. per doz. for Ivory 2-gang two way S.P. types.

New Siemens Infra-Red heater

INTRODUCTION of a new Infra-Red heating unit is announced by SIEMENS ELECTRIC LAMPS AND SUPPLIES LTD., 38/39 Upper Thames St, E.C.4.

Suitable for the rearing of pigs and chickens the new unit uses a 250 W i.r. lamp for direct mains operation with pearl finish instead of the usual series burning lamp.

With the porcelain holder lamp, and metal reflector, the price is 23s. 6d. tax free. This new unit avoids the need for two units in series and is more economical—replacement lamps cost 9s. 8d.

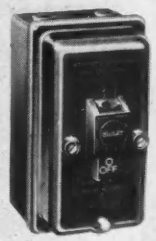
Glass door for E.E. Cookers

A GLASS panel door available as an optional extra for the 2009 and 2011 cookers made by ENGLISH ELECTRIC CO., LTD., Queen's House, Kingsway, W.C.2. Price is 15s.

Made of specially-tested non-splintering toughened glass the door will be appreciated by the housewife who wants to watch cooking progress and will assist demonstrations on E.E. cookers.

New Style Leakage Breaker

EXPERIENCE gained with earth-leakage circuit-breakers in operation over many years is applied in the design of a new 60 amp. double-pole model recently introduced by W. T. HENLEY'S TELEGRAPH WORKS CO., LTD., 51 Hatton Garden, London, E.C.1. The circuit-breaker mechanism is mounted on an insulating base not forming part of the outer casing, the casing itself being moulded from a high grade insulating material. Instead of the usual type of operating handle, there is a vertical slide clearly marked for "on" and "off" positions. Resilient packing carefully placed, together with rubber bushes at cable entries reduce the danger of trouble arising from the entry of dust and moisture. Operation is by a mains voltage solenoid, which is switched by a relay sensitive to the leakage voltage.

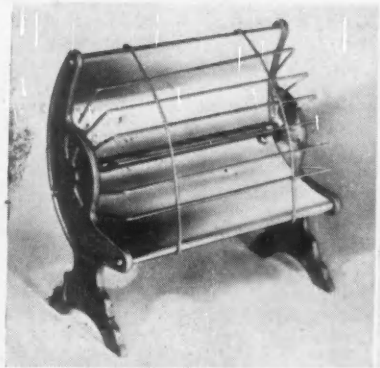


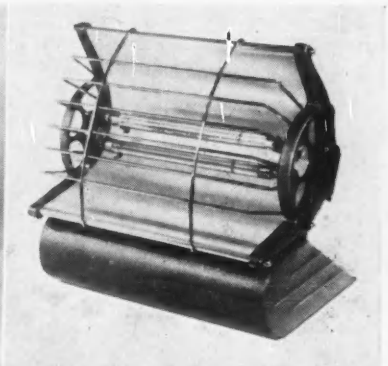
Henley's new 60 amp d.p. model

For the Electrical Trade

Reeves New Season's Fires

PARTICULARS of a new range of fires, all of which are new designs, have been released by REEVES ELECTRICAL AND RADIO CO., LTD., Reelek Works, Baldock, Herts. The Wizard, available in 1 and 2 kW loadings, has a heavy chromium reflector and full guard. Side castings are of aluminium and base of heavy gauge steel. Prices 40s. plus 14s. 8d. tax (1 kW) and 50s. plus 18s. 4d. tax for 2 kW size. The Adjustable is similar in style to the Wizard. It is available in two sizes and prices are 45s. plus 16s. 5d. tax (1 kW) and 55s. plus 20s. 2d. tax (2 kW). A smaller fire, of 750 W only, known as the Screen type, is constructed of steel, has a plated reflector: is priced 27s. 6d. plus tax 10s. 1d. The Popular is made of steel, has a plated reflector and guard and is manufactured in two sizes 750 W and 1,500 W, priced 20s. plus 7s. 4d. tax and 35s. plus tax 12s. 9d. respectively. With aluminium cast ends, plated reflector and full safety dress guard, the Minor is manufactured in one size only, 1kW, and is priced at 32s. plus tax 11s. 9d. The last fire, the Handy, comes in two sizes 750 W and 1,500 W priced at 20s. plus 7s. 4d. and 35s. plus 12s. 9d. respectively. Colours available for all fires includes cream, biege, silver-grey, and pastel shades of green and blue.





Reeves Adjustable and the Handy (right)

PROBLEMS AND PRACTICE

In Engineering

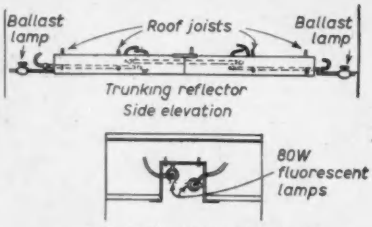
Every engineer has a story to tell; why not tell yours on this page? We welcome contributions to this feature, and those published will be paid for at our standard rates. Problems which are encountered and overcome in day-to-day maintenance or installation of electrical plant; useful methods and techniques developed for specific jobs, or current practices, all make instructive reading for others. We will also consider for publication problems requiring an answer. Sketches are often helpful and need only be rough, as they will be redrawn before use.

Special Trough Reflectors

THE internal illumination of showcases in shops, and concealed strip lighting in restaurants and hotels, is generally best accomplished by the use of tubular fluorescent lamps with their evenly distributed surface brightness and low surface working temperature. Since however the level of illumination required is in most cases obtainable only by the use of 5 ft, 80 W, or 4 ft, 40 W lamps, it is often awkward to fit these long lamps in line with each other within the limits of the fitments concerned when it is desired to recess the lamps from visual attention.

Such a case occurred recently where it was required to illuminate four showcases of 13 ft length each, and two showcases of 9 ft length each. These cases had fully mirrored backs internally and were existing along the walls of a high class shop, where it was essential to ensure that no glare or reflection was caused. Therefore it was decided to recess the 80 W fluorescent lamps within the ceiling recess of each case, suitable reflectors being required to house the lamps.

In this proposal the difficulty arose that there were no available manufactured troughs suitable for such an installation, and also the cases were not long enough to permit lamps being laid in line end to end, so a special design was evolved to suit the job. From $\frac{1}{16}$ in. thick sheet metal, a trunking of 4 in. sq. end section with projection lip of $\frac{3}{4}$ in. along each length was made up into 6 ft lengths, and the internal surface sprayed with a matt surface of reflecting white enamel.



Construction of the trough reflector, shown here, allows it to be adjustable

Recesses to accommodate the troughs were then cut into the case ceiling as long as possible, the lengths in each case being 12 ft and 8 ft respectively; due to the curved end walls of the fitments. It was also impossible to introduce any component longer than 6 ft into the cases and therefore the trunking was made up into the requisite lengths by sections, the junctions being secured by normal trunking capping and screws.

Next the fluorescent lamps were laid in the full length reflector, and No. 5 Terry clips were screwed into the reflector ceiling and walls to permit the lamps to be fitted on the diagonal axis of the trunking section for compactness. With clips fixed and lamps fitted, holes were drilled for the t.r.s. flexible cable to enter the trough for the lampholders.

Fortunately the showcase ceilings had roof joists which were notched to receive the reflectors, with wood screw fixings into the joists. Had this not been possible fixings could have been made by a series of small wood screws along each lip edge of the troughs although these lips were for screening the ragged cut edge of the ceiling recess and prevention of dust falling into the showcases. To avoid difficulties later in gaining access to starter lamps and chokes, it was decided to use ballast lamp circuits, the ballast lamps being recessed into the showcase ceiling at the curved end walls or centre section to supplement dark spots at these points.

The reflectors were then split into their component parts and reassembled in their respective positions and the lamps fitted, the resultant effect being an almost shadowless evenly distributed illumination, the overlapping of the tubular lamps being of great assistance. By such means any length of recessed fluorescent lighting can be made up to suit requirements not catered for by the normal fittings available.—*J. R.*

Motor P.F. Correction

A SQUIRREL cage motor of 40 h.p. was required to drive a temporarily installed plant in a section of the factory where the distribution cables and switchgear were already running close to capacity. The duty would be intermittent, the motor running at a low power factor for considerable periods, making the question of power factor correction one of importance. The only readily available capacitor was one of 16·5 kVA at 440 V used in conjunction with a welding machine, which at this particular time was undergoing some extensive repair.

A recollection relative to the rating of a capacitor connected to an individual motor being such that under every condition of loading a leading power factor is not obtained (due to the danger of over-voltages set up by full excitation of the motor), made the suitability of this available capacitor one for consideration. The following details of the motor no load and full load currents, and the assumed power factors for both before correction, were therefore used to estimate the corrected p.f. and to check that between these two conditions a leading p.f. would not be obtained.

The motor took a full load current of 55A at 0·86 p.f. and a no load current of 25 A at 0·25 p.f. The capacitor charging current at 415 V was 20·5 A.

	Full load	No load
Wattfull component .	47·3 A	6·25 A
Wattless component .	28·0 A	24·0 A
Capacitor charging current	20·5 A	20·5 A
Total wattless component	7·5 A	3·5 A
Total current ...	48·0 A	7·0 A
Power factor ...	0·985 Lag	0·9 Lag

If the wattfull component is represented by I cos ø, the wattless component by I sin ø and the capacitor charging current by I_c, then after correction the total wattless current is I Sin ø$-I_c$ and the total current $\sqrt{(I \cos \phi)^2 + (I \sin \phi - I_c)^2}$.

It appeared from the above that the prescribed conditions were fulfilled, the motor no load magnetising current being greater than the capacitor current, whilst giving maximum correction at full load. After the plant was put to work and more time was available, the question of capacitor ratings for individual motor correction was looked into and Code of Practice CP 321.102 disclosed that the capacitor current should be 85% of the motor no load current. Checking this against the temporary installation reveals how singularly appropriate was this sole choice of capacitor.—*T. H. Snelson.*

Live Neutral

I SHALL always remember being urgently called out to a large house in a country district to attend to the electrical installation. The cause for alarm was first set up by a cow, who was seen to go to a drinking trough at a nearby farm and then quickly draw away from it. The farmhand thinking this to be a strange thing, touched the trough, found it alive and at once reported it.

Upon arrival at the house, I went to the place where the service entered and found the meter to be rotating in no uncertain manner. Opening the main switches, one by one, I found that the earth fault was on the heating supply. I proceeded to locate the fault in the usual manner and found that it was on the lead sheathed main cable to the heating sub-fuse board. The cable ran under screwed floored boards, and on carefully lifting out those immediately above the fuseboard I found that a screw which

held the floor board had passed through it between the live neutral conductors. As this cable was the heating main a fuse in the nature of 60 amps was incorporated in the main switch.

Having carried out the necessary repairs to the cable, tests showing satisfactory insulation, I next located the point at which the whole installation was earthed. It was efficiently boarded in the proper manner to the local water supply main pipe (galvanised iron) which also supplied the nearby farm in question and other surrounding places in the district.

In view of what had happened, it was necessary to augment this "earth" with a copper earth plate 3 ft sq to which was connected a short length of 7/·064 copper wire. The plate was buried 5 ft deep in the earth near the mains position outside the house, in a spot where the earth around was always wet and hence giving no fear of its becoming dry. To it was connected both the installation and original earths. A further earth test was carried out and a reading of 1 ohm in relation to the supply neutral was obtained.—*J. H. Robinson.*

Thermostatic Oven Control

IN its original state a thermostatically controlled oven gave control within ±10°C: modifications enabled ±1½°C to be obtained from it. The small oven concerned had several heaters, each of which could be switched on successively to give temperature rises of 60°C, 120°C and so on. The "control" heater only was relay-controlled from a bi-metal strip thermostat, so that (for instance) for a required temperature rise of 90°C, the first heater only would be switched on permanently, and the thermostat would keep the "control" heater on for about half the time.

The weakness of this control on a small oven is that the heaters are sufficiently powerful to give a large rate of rise of temperature to the air inside the oven, and the thermal inertia of the thermostat element is such that by the time it becomes heated to its operating temperature the oven air has become much hotter than it is required; similarly with cooling. A range of ±10°C was found to arise from these causes in the oven in question.

To improve the temperature control it was thus necessary to decrease the rate of change of air temperature so that the thermostat temperature could more closely follow that of the air. This was done, for a required temperature rise of about 50°C, to give a constant oven air temperature of 70°C, by putting a resistor in series with the first heater and adjusting it so that with this heater only switched on, the ultimate oven air temperature was about 65°C. A resistor was then put in series with the "control" heater so that with this heater also switched on the ultimate temperature was about 75°C. The rate of change of temperature under these conditions was thus reduced to roughly 5°C per hour, both for heating and cooling, at a temperature of 70°C.

The thermostat was then adjusted so that it switched the "control" heater off as the air temperature passed through 70°C; it was then found to switch it on again before the air temperature had decreased to 69°C, so sufficient sensitivity had this way been obtained. However, inconsistency of behaviour within the thermostat between successive heating cycles resulted in the long-term temperature control becoming ±1½°C rather than the ±½°C which seemed possible from the initial setting.

The chief weakness of this method of increasing the closeness of control of an "on-off" system, by reducing the control range and the rates of change within this range, is that the system can no longer contend with large changes in external conditions. In this example it was judged —correctly, as experience showed—that a control range of ±5°C was ample to allow for the random changes in test-room temperature and supply voltage.

It may perhaps finally be added that if this oven was often required to give such closely controlled temperatures, a more sensitive thermostat would have been obtained and fitted, though some reduction of the control range would still probably have been necessary.—*B. J. P.*

BRITISH STANDARDS

British Standards Institution Yearbook, 1954. *Price 12s. 6d.* As usual, the main purpose of this invaluable reference book is to provide a record of current British Standards. In the present edition the list is complete up to 31 Mar. last. As regular users of the Yearbook will be aware, however, more than a mere index is presented. Each standard is summarised as to its application and its contents. In addition there are lists of other B.S.I. publications such as the Codes of Practice, treated in the same way, and an up-to-date list of the membership of the principal B.S.I. committees. The Yearbook inevitably grows with the work of the Institution, and this year it totals 508 octavo pages.

Metallic Resistance Materials for Electrical Purposes. *B.S. 115:1954. Price 3s.* In this revision of a standard last issued in 1938, metallic resistance materials are divided into three classes as compared with five previously. The first class applies where low temperature coefficient of resistance is of importance, as in precision instruments, the second where this factor is still important, but where larger values are acceptable, and the third where suitability for working at temperatures of 250° C or above is the main requirement. This last class is subdivided into six further classes according to the maximum temperature involved. All references to resistance castings have been omitted in this edition as the specification of tests has proved impracticable. Electrical requirements for resistivity and resistance and the associated tolerances are unchanged from the last edition as are dimensional tolerances.

Impregnated Paper-Insulated Cables for Electricity Supply. *B.S. 480:1954. Part 1: Lead or lead alloy sheathed cables for working voltages up to and including 33 kV, price 6s. Part 2: Aluminium sheathed cables for working voltages up to and including 22 kV, price 5s.* Each part of this standard contains "quality" clauses dealing with the composition of the various components of the cable. A basic reference temperature of 20°C for the properties of annealed high conductivity copper has been adopted The practice of specifying minimum and maximum diameters over sheath and overall has been abandoned in favour of nominal diameters. Cables which comply with the requirements for minimum thickness of insulation and sheath will have the stated nominal diameters, which allow reasonable manufacturing tolerances.

Tests are now divided into acceptance tests and sample tests. The former consist of the conductor resistance and voltage tests, as in previous editions, with a dielectric power-factor/voltage test for 33 kV cables only. Bending and drainage tests are specified for use when required as sample tests and the voltages to be applied after the bending test have been increased for working voltages up to and including 11 kV. A physical examination of the test sample after the bending test is now specified, with the intention of accumulating data for a future revision of the standard. The bending test for aluminium sheathed cables requires two cycles of operations compared with three for lead sheathed cables. Test voltages for application after installation are the same for both types of cable.

Part 2 applies only to cables with swaged seamless aluminium sheath for working voltages up to and including 22 kV. Such cables, owing to the comparative hardness of the sheath, are not generally required to be armoured but, for special conditions where armouring is considered necessary, dimensions are specified.

Cotton covered round copper wires (metric units). *B.S. 2084: 1954. Price 2s. 6d. net.* Prepared primarily from the point of view of exports, this standard differs from B.S. 1791:1951 only in that all quantities are expressed in metric units, the range covered being from 0·15 to 5 mm. For normal purposes, B.S. 1791 continues to be the appropriate U.K. standard.

British Standards reviewed above may be obtained at the prices stated from the Sales Dept, British Standards Institution, 2 Park St, London, W.1.

NEWS OF THE WEEK

B.E.A. Offer of £100m Stock

LOAN OBTAINED AT CHEAPER RATE

PROSPECTUS for a new issue of £100 million guaranteed stock by the British Electricity Authority at 3½%, 1976-79, was published on Monday. The list of applications was opened and closed yesterday (Wednesday), after we went to Press. This loan had been rumoured for some weeks and consequently was not wholly a surprise, although the amount was somewhat lower than anticipated in some quarters; —an advantageous factor. It is to be issued at 100½ as compared with the comparable issue in May 1950 at 99. It is a notable fact that in this issue the Authority have reverted to their former terms of borrowing and the new stock will indeed be an addition to the £150 million of similar stock issued in 1950. Last year the B.E.A. issued £125 million of stock at 4¼% redeemable in 1974-79. They offered it at par compared with the similar issue a year previously, offered at a discount of 1%.

The new issue brings the total of stock created since Vesting-day to £625 millions apart from the compensation stock. This figure is made up as follows:

			£m
Oct. 1948	3%	1974–77	100
May 1950	3½%	1976–79	150
April 1952	4¼%	1974–79	150
April 1953	4¼%	1974–79	125
Aug. 1954	3½%	1976–79	100

In addition there are, of course, the temporary borrowings of the Authority. In the most recent Treasury guarantee, these short-loan borrowings were covered up to £130 millions for dates up to 30 Sept. We understand that at 31 July BEA borrowings amounted to £104,645,000.

MODERN U.K. AT CANADA'S NATIONAL EXHIBITION

THE "Modern U.K." stand organised by the Board of Trade and Council of Industrial Design for the first time at last year's Canadian National Exhibition, and which won the star award as the best display in the British section of the Government Building, is being repeated at this year's event. At the 1954 exhibition, to be held in Toronto between 27 Aug. and 11 Sept., some 500 different products will be shown, chosen from those which U.K. manufacturers have submitted as suitable for the Canadian market. Canadian buyers and representatives of Canadian stores in London have inspected the goods, and helped in selection. We note that a good range of electrical appliances is included. Among them are the English Electric 2011 cooker, a Fillery's (Great Britain) suction cleaner, floor polisher and scrubber, a Morphy Richards iron, and E. K. Cole space heater, a cleaner made by Hoover Ltd., and a refrigerator by the International Refrigerator Co. Lighting fittings on show were made by George Forrest, H. C. Hiscock, Hiscock Appleby, The Merchant Adventurers and Troughton and Young. Finally there are electric wall clocks by Smiths English Clocks and Gent and Co.

Electronics Symposium

IT was announced at the Scientific Instrument Manufacturers' luncheon that the association would be holding an electronics symposium and exhibition at the Birmingham Chamber of Commerce from 23 to 25 Nov.

NORTHMET SUB-AREA CLAIMS £1¾m TURNOVER

THE Southern Electricity Board's claim on behalf of their Newbury sub-area that it was the first sub-area in the country to achieve an annual turnover of £1 million has already been strongly disputed. With so much activity on the sales side in the electricity supply industry these days (as we commented last week) it was hardly likely that such a claim would be allowed to go unchallenged. The counter-claim comes from the Eastern Board who point out that Newbury's figure has been exceeded for the fifth successive year by their Northmet sub-area. The latest figure for Northmet they state, is in fact over £1,750,000. Not only that but the Board goes on to state that their Essex sub-area has also exceeded the £1 million mark, although they just failed to do so in the 12 months ended 31 Mar. last. It would appear that Newbury will have to work even harder to beat this challenge, but there is a strong suspicion that we have not heard the last of sub-area turnovers.

Air Pollution discussed

LATEST organisation to give attention to atmospheric pollution is Political and Economic Planning. A recent issue of *Planning*, the organisation's periodical is devoted to this subject, discussing both the legal and practical sides of the problem. In view of the pending report of the Beaver Committee on Air Pollution, no comprehensive solution is discussed. Considerable attention is given to generating stations, particularly with reference to flue gas washing for the removal of sulphur. It is recognised that the argument that flue gas washing may worsen the pollution position "may have some substance," but the importance of having high chimneys in any event is stressed. It is considered overall that given the necessary effort, the pollution position may be much improved.

Persia—New Opportunities for U.K. Exporters

FOLLOWING the conclusion of the Persian oil negotiations, it can reasonably be expected that fresh opportunities will present themselves to U.K. firms for the supply of goods and services needed in the long overdue development of the country. The oil dispute must have played havoc with Iranian economy, and coming so soon after the war, during which her trade relationships with Germany, previously exceptionally strong, were severed, the overall result must have been critical. Not least to suffer was the Persian Seven-Year-Plan, an ambitious programme but depending to no small extent on the income to be derived from oil.

We note that the Board of Trade is eager to provide specific information about exports to manufacturers, but information as to the country's immediate needs is very limited. No doubt this will be rectified as soon as possible, but meanwhile information is unavoidably old, though not necessarily out of date. Any development will have to involve electricity supplies and provision of electrical goods. A few years ago power supplies in the towns were inadequate and in the country districts non-existent. Plant was old and in need of repair or replacement. There must therefore be a big demand for generating plant especially. Under the Seven-Year-Plan it is planned to spend some 1,000 million rials on water supply and electricity schemes. In this connection we noted last January that a contract for the construction of a large dam had been placed with a French group of engineering contractors. This project will include a power station and is estimated to cost 8,000 million francs. This must be only an example, and one of a number of such schemes.

Ecuador Well Worth Attention of U.K. Manufacturers

ALTHOUGH twice the size of Great Britain, Ecuador has fewer than 3,500,000 inhabitants, the majority of whom are peasants having an elementary standard of living. The Overseas Economic Survey for that country, just published for the Board of Trade, points out, however, that industry is developing and although the country has not entered into the age of modern American development, it stands on the threshold, and is consequently well worth the attention of U.K. exporters. Such are the expectations that Germany, the U.S., and more recently Japan too, are competing strongly, the first particularly as regards electrical commodities. But the U.S. with the advantage of her close proximity, also enjoys a good market in this field. Electrical goods, in fact are not yet to be found among the major items exported to Ecuador by the U.K. Nevertheless, the opportunities exist.

Industrialisation is not far distant, but as usual much will depend on improvements to the country's power supply, principally by the exploitation of hydro-electric resources. Plans for this have been elaborated with the help of a U.N. expert. He put the demand of present consumption at 110,000 kW in his Five-Year Electrification Plan (1953), but estimated that it could be more than covered by available hydro-electric power. Power production in March last year was 44,965 kW.

UV Rays Combat Pig Influenza

IN the piggeries of Ellerslie Farms Ltd, at Crosby, Isle of Man, Philips Electrical Ltd's TUV Ultra-Violet Germicidal Tubes are being used with considerable success in the farmers' constant fight against contagious pneumonia, commonly known as pig influenza. Much has been done to prevent the spread of contagious diseases, but despite numerous precautions the outbreak of certain illnesses is still prevalent, especially pig influenza. The first full-scale investigation of U.V. Radiation was carried out in Sweden with encouraging results. Tests proved that the installation produced a lower percentage of substandard animals, a lower mortality rate, more rapid growth and great weight increase per fodder unit.

For irradiating pigs for fattening, it was found that one 15 W Philips Germicidal Tube, mounted centrally, was sufficient for 150 sq ft of floor space. One 15 W tube, similarly mounted over every 200 sq ft of floor space, sufficed for mother sows and their litters. A minimum distance of 6 ft (8 ft for sows and litters) was maintained between the point of mounting and the eyes of the animals. Continuous operation—apart from when personnel were in the pens—was carried on.

Main results achieved at Crosby are the cessation of respiratory disease, the marked absence of flies and insects, and freedom from sunburn when the pigs are turned out into field arks.

OFFICIAL PUBLICATIONS

BRITISH STANDARDS

B.S. 480, 1954: Impregnated Paper-Insulated Cables, Part 1: Lead or Lead-alloy sheathed cables for working voltages up to and including 33 kV, and Part 2: for working voltages up to 22 kV.

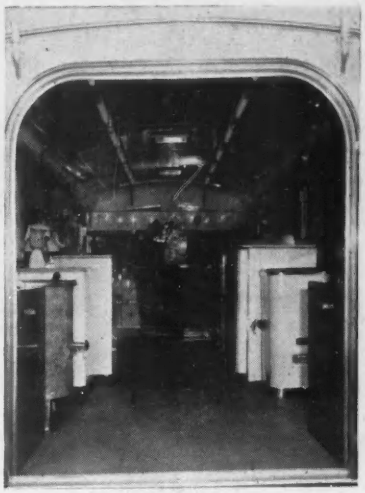
OVERSEAS ECONOMIC SURVEY.

Ecuador (see this page). HMSO. 2s.

Two Companies Merge

IT WAS announced by Permali Ltd, last week that subject to the necessary consents being obtained, a merger has been arranged between that company and Hordern-Richmond Ltd. Mr L. Robson, chairman of Hordern-Richmond, will join the board of Permali Ltd, who make densified wood laminates and bakelised paper products for electrical insulation.

New showrooms have been opened at 25-27 Dale End, Birmingham, by the Midlands Electricity Board for the display and sale of electric commercial catering equipment and commercial refrigeration apparatus. We hear that two items which attracted much attention on the opening day were the Freshel vegetable refresher and the infra-red grill.



Interior view from the rear doors of the Eastern Electricity Board's latest mobile service centre.

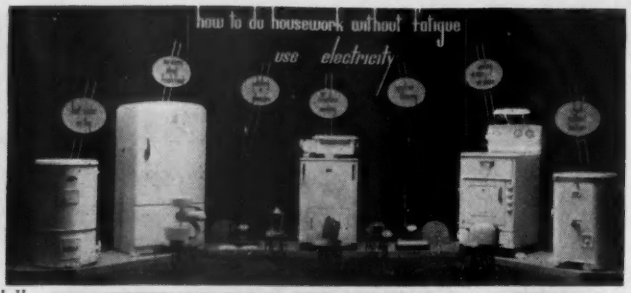
New Mobile Showroom to tour the Fens

LATEST addition to the B.E.A.'s fleet of mobile service centres is that put into operation by the Eastern Electricity Board in their Fens sub-area. The caravan made by Tickfords Ltd is 22 ft long by 7 ft 8 in. wide and is mounted on a single axle chassis and towed by a Land Rover. There is a removable display counter and cash desk which can be transformed into a demonstration table if required, and there is plenty of space for the display of one each of the main domestic appliances. For demonstration purposes, the centre can seat about 12-15 people. The wiring installation, controlled by a main switch in the cupboard, is supplied with power from a 12 V battery, or if available, a mains cable. Lighting is by fluorescent tubes. This new mobile showroom will undoubtedly prove an asset to the Board especially in the numerous agricultural shows held in the area.

It will be recalled that last week we noted the S.W. Board's new mobile centre, but another Board with the same ideas at this time is the Merseyside and N. Wales Board. They already have a number in service but others will be added to the fleet shortly, we hear. The new vans are expected to concentrate on advising farmers how best to utilise their power supplies, and on demonstrating appliances on new housing estates.

SOVIET CABLE ORDER

IT was announced by Crompton Parkinson Ltd. on Tuesday that they have successfully completed negotiations with Raznoimport, Moscow, for two contracts for paper cables and wire. These goods are to be used for transportation purposes, and deliveries will be spread over six months. Value of the contracts amounts to £1,700,000.



Mr H. J. Randall, chairman of L.E.B., presents the display Trophy to Mr Harris of the Edgware Rd centre whose display is shown top left. On the right is the display at Eltham, and top right Walthamstow

Edgware Rd. win Display Contest for Third Time

RAPIDLY making a name for themselves in the world of display and presentation of goods are the staff of the Edgware Rd service centre. For the third year out of the four so far, these showrooms have carried off the trophy in the London Electricity Board's annual window display competition. This contest was first held in 1951, and the following year must have been a black one for Edgware Rd, for they did not win, having to be content with a mere second place to the Walthamstow service centre. The latter took third place this year. Second place in the 1954 competition went to the Eltham service centre, the first time they have appeared in the list of prize-winners.

The competition took place last April when senior officers of the Board selected 12 window displays and submitted them to the final judges. The theme selected was "Housework without Fatigue." The shield and certificates were presented to the successful entrants at St. Pancras Town Hall at the end of last month, when the judges remarked on the high standard of display achieved.

The winners pointed out that electricity provided "piping hot water for sparkling dishes, brilliant whites, without hot fires." Eltham asked passers-by "Why get tired, electricity doesn't." "How to do Housework without Fatigue—use Electricity," was the message imparted to Walthamstow housewives.

Jubilee Celebration of Thermionic Valve

THE jubilee of the thermionic valve is to be celebrated by the Institution of Electrical Engineers on 16 Nov., it was announced last week. On that date, 50 years ago, Sir Ambrose Fleming applied for the British patent of his thermionic valve. Proceedings will be opened by the Lord President of the Council, the Marquess of Salisbury, and three talks will be given on valves, tracing their history from the earliest developments. Lecturers will be Sir Edward Appleton, Prof G. W. O. Howe, and Dr J. Thomson. An exhibition of historical apparatus will also be held.

Bigger Electrical Pavilion

THE European Trade Fair at Strasbourg has, in the past four years, gradually been increasing in status and gaining in international importance, but hitherto the electrical industries have unfortunately had one of the smallest pavilions. Over 100 British firms have taken space at this year's Fair, to be held between 4 and 19 Sept., and British electrical interest is especially limited. It is consequently pleasing to note that it is intended to give electrical interests a larger section at next year's Show, bookings for which are already being accepted. Average number of visitors per day last year was 41,000.

Middle East Prospect

SPECIAL emphasis has been laid in recent months on the opportunities presenting themselves in the Middle East to British exporters. Not without good reason is the U.K. holding her own trade fair in Baghdad at the end of October. This is mentioned because we heard last week of a company in the Lebanon which is anxious to contact British manufacturers of all kinds of electrical goods. The company concerned is the Anglo-Syrian Construction Co., P.O. Box 831, Beirut, and the enquirer is Col A. B. Barrington. Territory covered includes Syria, the Lebanon, Jordan, Iraq, the Arabias and the Persian Gulf. The type of electrical articles is not specified but our informant mentions the substantial increase in building and public works and constructional activities.

19 Blondes to compete for Queen of Light Title

BRITAIN will again have a Queen of Light this winter. The ancient festival dating back to pagan times, and still a popular custom in Scandinavian countries is being revived by the British Thomson-Houston Co., Ltd. The competition which the company is organising is open only to blonde girls, since a dark Queen would be a contradicton in terms, and both local Queens and the national Queen must guarantee to keep their hair blonde for their year of office, when they will attend civic and other functions. The nineteen finalists will be drawn from heats held at Morecambe, two districts in Manchester, Cardiff, Glasgow, Newcastle, Belfast, Sale, Aberdeen, Bristol, Liverpool, Nottingham, Leeds, Edinburgh, Birmingham and four London districts. The first contest will take place at Morecambe tomorrow afternoon, and later the elected queen will take part in the switching-on ceremonies of the resort's illuminations. The national Mazda Queen of Light will be enthroned in London on 21 Dec.

The First Half-Century

Are electric waves telegraphs? is a question that is worrying a good many people just now. The puzzle calls to mind the fight about the telephone, and reminds one of the difficulties the engineers had with some of the counsel in that case. One of the leaders was specially obtuse, and some of the electricians spent from four o'clock to midnight trying to explain matters to him. At last he said "Now I understand the thing quite clearly. It is really quite simple. You speak into this mushroom-shaped thing at one end and it comes out at the other in dots and dashes. But why did you not say so before?"—*From our issue of 18 August, 1904.*

Modern Theatre Lighting in Three Cities

CINEMA and theatre lighting is in the news this week with three recent and exemplary installations carried out in London, Leeds and Aberdeen. Co-operation between architect and lighting engineer is a feature of the newly-completed Vanbrugh Theatre of the Royal Academy of Dramatic Art which is to be opened by H.M. the Queen Mother on 2 Dec. Main auditorium lighting is from a fibrous plaster trough spanning the theatre and suspended just below a vertical break in the ceiling line used for spotlights. The trough houses a continuous line of 5 ft 80 W tubes each side, controlled by an automatic dimmer. Above the balcony are three specially-designed fittings comprising metal troughs to take tubes below plaster recesses. Below the balcony incandescent units are used with glazed bases recessed into shallow plaster domes housing 100 W clear lamps. The fittings used were supplied by Thorn Electrical Industries Ltd., who were also responsible for the stage lighting, a cyclorama batten and a cyclorama ground row, each incorporating 20 fluorescent tubes dimmer-controlled, in four colours. Strand Electric co-operated with the stage lighting and Bective Electrical Co., Ltd., were the contractors.

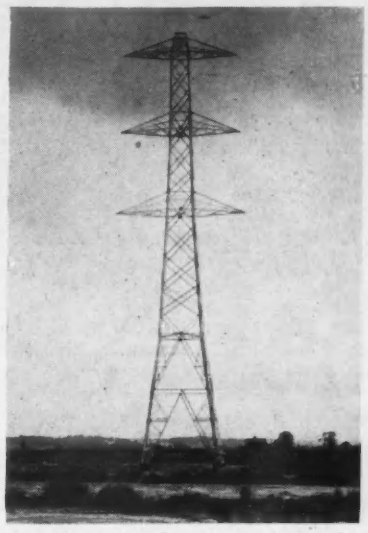
The Dominion Cinema in Leeds claims distinction by reason of its resurrection from a gutted shell caused by fire in the early part of the war. Main point of interest is probably the large suspended central feature in which is a continuous row of 27 5 ft 80 W peach fluorescent tubes. To overcome the problem of maintenance a cat-walk has been included down the centre of the huge fitting. Once again Thorns have provided colour illumination using dimmer-controlled fluorescent tubes for the stage curtain and proscenium arch. Contractors were Stokes Electrical Contractors Ltd.

Thorns third achievement in recent months was at the Regal Cinema, Aberdeen, where once again their research in the dimming of fluorescent lamps for auditorium lighting was put to good use. The Regal, incidentally, is one of the first completely new cinemas to be opened since the war. No fewer than 139 4 ft 40 W and 44 18 in. 15 W tubes have been employed in the auditorium. They are arranged in three transverse curves in the main ceiling, two over the balcony and one beneath the circle. Control gear consists of five twin electron dimmers and one single electron dimmer. Massed 3 ft 30 W white tubes are used behind Tremolux glass at entrances.

Thorn Electrical Industries received the full co-operation of electrical and other officials of A.B.C. Installation was by W. C. Martin of Glasgow.

Exports to Argentine

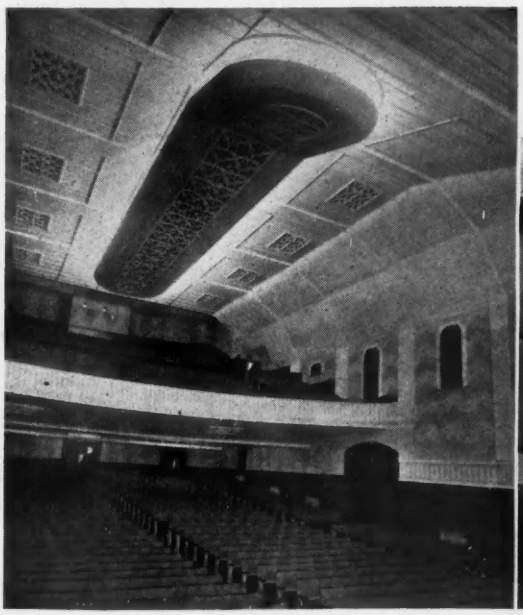
THE Argentine is to intensify the importation of equipment required urgently for the country's industries. A revision of import policy was announced last week in Buenos Aires. Import permits will be granted on an industry-by-industry basis after consideration by the General Economic Confederation. One important aspect of the announcement is that priority will be given to the electric power industry. The authorities have decided to withdraw circulars governing instalment buying of imports (the forward payments plan) but an exception has been made as regards electrical goods. The Central Bank will accept requests for imports at official exchange rates for machinery and equipment in that industry from specified countries, which includes the sterling areas.



Our illustration shows one of the first towers to be erected in connection with the B.E.A.'s 275 kV double-circuit line between Staythorpe and Drakelow. It forms part of the 275 kV British Grid Scheme and is 47¼ miles long. Installation is being carried out by W. T. Henley's Telegraph Works Co., Ltd., and consulting engineers are Merz and McLellan

Scientific Films at International Congress

CONGRESSES of the International Scientific Film Association are now well established international events, and we note that the eighth is to be held at the University City and National Research Council in Rome between 6 and 12 Nov. U.K. enquiries should be addressed to the Scientific Film Assoc., 164 Shaftesbury Ave, London, W.C.2.



Below, the new Vanbrugh theatre in London to be opened in December and left, Leeds' Dominion cinema with its large central feature, which includes a cat-walk for maintenance purposes

NEWS IN BRIEF

Passenger-carrying electric trains will link Sheffield and Manchester from 20 Sept. This means that the whole of the Manchester-Sheffield-Wath electrification scheme will be virtually complete.

Nu-Swift Ltd have received the first order for their Chloro-Flash Extinguishers for use in aircraft of the Royal Danish Air Force.

Prospectuses of day and evening courses to be held at Hackney Technical College, Poplar Technical College and West Ham College of Technology have been issued. We note a short course of four weekly lectures on the M.K.S. System of Units by Mr C. T. Baldwin at West Ham beginning on 28 Oct.

The Sir John Cass College in Jewry St, Aldgate, E.C.3, is also offering a wide variety of courses during the coming session.

One of the study groups at the 22nd International Congress for Housing and Town Planning will be concerned with hydro-electricity in planning. The Congress takes place in Edinburgh between 19 and 25 Sept.

We hear that alternative tariffs for some Leicestershire cinemas are being considered by the C.E.A. following talks the Association has had with the E. Midlands Electricity Board. The latter have made suggestions for alternative tariffs.

An analysis of clerical salaries has been compiled and published in booklet form by the Office Management Association. This is the sixth survey of the kind undertaken. It costs 25s.

A priority list has been drawn up in Monmouthshire in respect of installing electric lighting in schools. First two on the list are said to be Crofield secondary modern school at Abergavenny and Gellicrug secondary modern school at Abertillery.

Sayings OF THE WEEK

"The Union of S. Africa should start to think about using its own uranium for producing electric power because all over the world coal will have to be used more and more for conversion into oil and petrol. The time might come when S. Africa will use its uranium to produce electric power and export its coal..." DR S. M. NAUDE, President, Council for Scientific and Industrial Research in Johannesburg.

"The practical application of atomic energy for industry is for technical reasons so closely related to atomic weapons production that international co-operation has been impossible..." DR GUNNAR RANDERS, Executive Vice-President of new European Atomic Energy Society.

ELECTRIC SUPPLY NEWS

Angus

The N. of Scotland Hydro-Electric Board's S. Angus distribution scheme, expected to cost about £190,000 was outlined last week by Mr A. Grant, the Board's area manager for S. Caledonia. The scheme is a continuation of the Board's policy to press ahead with rural distribution. It will cover the whole of the county within a line from Dundee along the coast to Arbroath, northwards to Friockheim, thence to Forfar and Newtyle and back to Dundee. The new project will take power to about 400 potential customers. Mr Grant said that like most other rural schemes, the S. Angus project was an uneconomical proposition, but that would be offset by the sale of surplus electricity in the S. Caledonian area to the Central Scotland area.

Derbyshire

The development of Drakelow power station has resulted in abnormal traffic on the Stapenhill—Walton road and Baron Lane, Drakelow, the County Council Bridges and Highways Committee has reported. This has entailed increased cost of maintaining and improving those roads, and the County Council claimed against the B.E.A. for a contribution towards the cost. Following negotiations, the B.E.A. is to pay the whole of the difference (£1,472) between the normal cost of maintaining the roads and the actual cost from November 1950 to date.

The County Council is to widen and strengthen the Drakelow road to carry normal traffic to and from the power station at an estimated cost of £3,080, subject to a B.E.A. contribution of 40%. Future claims for damage will be confined by the Council to that caused by heavy individual loads, each case being considered as the occasion arises.

Lancashire

The B.E.A. has received the consent of the Minister of Fuel and Power to the building of the second half of Bold power station. The authorisation covers the installation of three 60 MW generating sets, each served by a boiler with an evaporative steam capacity of 550,000 lb an hour, and the building of three cooling towers each having a capacity of 2¼ million gallons of water an hour. When completed the station will have a total installed capacity of 300,000 kW or 400,000 h.p.

Neston

The U.D.C. has been told by the Merseyside and North Wales Electricity Board that the supply voltage in the area is to be 240 V instead of the present declared 230 V. Consumers have been advised to have their appliances adjusted to the higher voltage, as the excessive voltage which was being supplied at the present time was not doing such appliances any good, Councillor W. H. Howe stated.

Lewis

A submarine cable has been laid across Loch Erisort, Lewis. It will provide electricity for about 350 householders in the scattered parish of South Lochs. The laying of the cable saved a detour of many miles over moors.

Northern Ireland

A decision is shortly expected concerning the proposed River Bann hydro-electric scheme. The matter awaits the return of the Minister of Commerce, Lord Glentoran, from holiday. He has now had for some time a report into the inquiry conducted last December concerning objections by landowners and fisheries to the plan for the construction of a 30 ft fall at Carnroe, near Kilrea.

Southern

The proposed 275 kV transmission line between Weybridge (Surrey) and Melksham (Wiltshire) was the subject of a Ministry of Fuel and Power inquiry held at Pewsey recently. Outlining the case for the B.E.A., Mr J. H. Geach said they were at a disadvantage because at no time had Pewsey rural council submitted an alternative. Major factor was the by-passing of airfields, of which there were three, and the route through the Vale of Pewsey was the only one left open. It was suggested that if the district had to accept the line, it would be best rerouted to run parallel with the existing grid. The inspector, Mr H. W. Grimmitt commented that the pylons (136 ft high) were not an eyesore. Answering the clerk to the council, who said they did not want the pylons at any price, he said it was impracticable to install the lines underground. The county planning authority had approved the proposal as there was no possibility of an alternative, and the C.P.R.E. had raised no objection. The inspector said he would tour the district and make special note of the suggestion that the new line should run parallel to the present line.

LIGHTING SCHEMES

Hitchin. U.D.C. are to borrow £1,794 for improving lighting in Bedford Rd.

Marlborough. The T.C. has approved a £5,100 trunk road lighting scheme, using 140 W sodium lamps.

Largs. The T.C. has approved a £2,620 scheme for improving lighting of secondary streets over a 4 year period.

Chilworth. The parish council propose to erect 30 street lamps at a cost of £1,130.

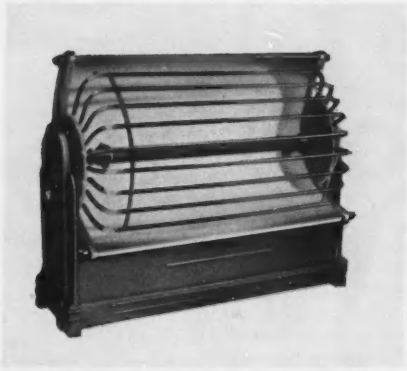
It's **MEM** again for top value in fires and convectors

QUALITY is better than ever in the new season's MEM range. All reflectors are brass, heavily chromium plated. Every fire and convector complies fully with BS 1670. This lays down stringent requirements for insulation, safety clearances, earthing and rust-proofing, thus ensuring complete safety, long life and reliability. You can offer this extra quality in all MEM fires at prices that mean quick, easy sales.

MEM fires are available in a choice of attractive colour finishes.

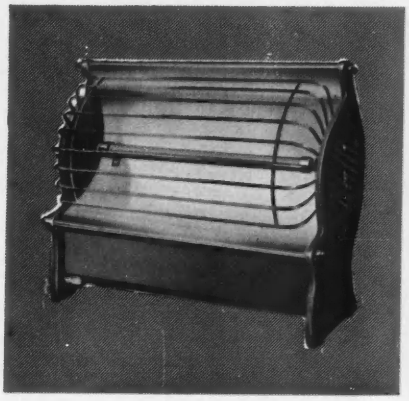
Each fire has a substantial safety guard complying with statutory safety regulations.

Send for new Fire List No 351.



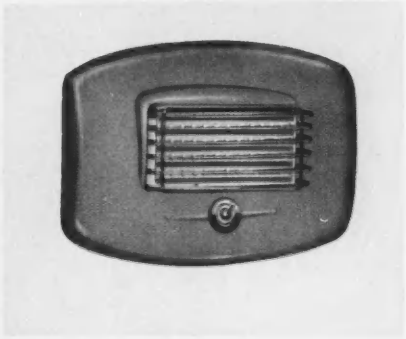
MEMRAY

Fine quality swivel reflector fire. Chromium plated brass reflector, efficient guard, robust cast construction. In 1 and 2 kW ratings.



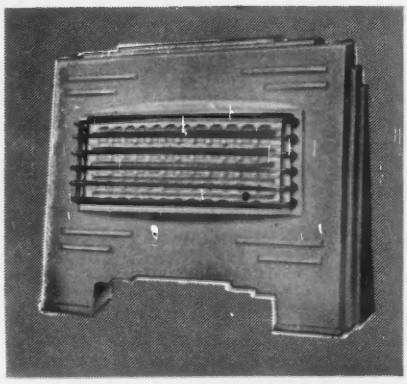
REFLEX

A sturdily built reflector fire offered at an attractive price. Cast iron sides, chromium plated brass reflector. In 1 and 2 kW ratings



PANEL FIRES

Attractive modern designs. The "Walbeam" Outset Flat Bar Pattern is designed for surface mounting. The "Walray" Inset Reflector Pattern is for recessing into wall or surround.

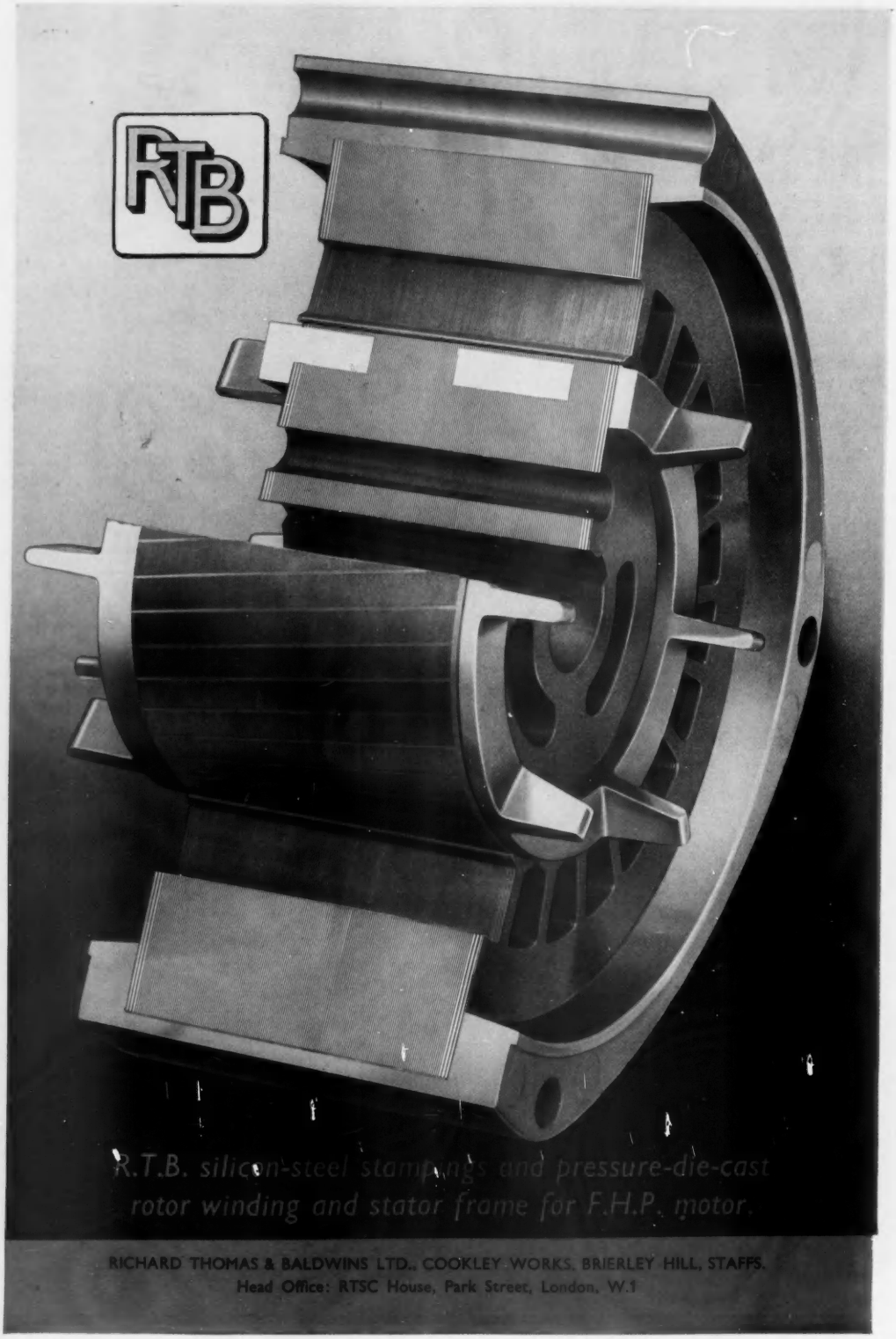


MAYFAIR

A really well-made bar type fire that will give years of good service. Attractive simple design. Sturdy cast frame. In 1 and 2 kW ratings.

MEMVAIR CONVECTORS. Keep in step with the growing popularity of convectors by giving a prominent place in your showroom to MEMVAIR convectors. Handsome, efficient and absolutely safe. Lovely bronze finish. In three ratings, 1, 1½ and 2 kW with or without thermostat.

MEM



RICHARD THOMAS & BALDWINS LTD., COOKLEY WORKS, BRIERLEY HILL, STAFFS.
Head Office: RTSC House, Park Street, London, W.1

COMPANY ACTIVITIES

The price of the employees' "A" 1s. shares of Hoover Ltd., have recently outstripped the price of the company's 5s. Ordinary shares, on reports that there was likely to be a scheme of reorganisation of the share capital which would give each "A" share rights in excess of those attaching to each unit of Ordinary stock.

A statement by the board now discloses that a scheme was under discussion but it was not to have been so favourable as market reports suggested.

It would appear that the issue of these "A" Ordinary shares to high executives, and the setting aside of some of them for the benefit of all the staff has turned out to be somewhat ill-advised.

Last year, for instance, profits were £3,095,000. Under the arrangements made, the "A" dividend was, by this profit, limited to 372·61%. The Ordinary dividend to correspond, had to be a minimum of 37·02%. It was, in fact, 45%.

The important point now is that if profits rise this year, the "A" dividend must go up irrespective of whether the Ordinary remains at 45% or not. Actually the "A" dividend could go up to nearly 560% before it would be restrained by the 45% rate on the Ordinary.

The board's dilemma is what to do now. The terms of exchange are almost certainly going to be one-for-one, but such a scheme now would not please those who have been rushing after the "A" shares.

As an onlooker, it appears to me that the speculators have only themselves to blame, and for the immediate future, holders of the "A" shares are probably better without the scheme.

Should Hoover profits rise this year to £4 millions or over, as they may well do judging by the activity in the consumer goods trades, they can expect a dividend in the neighbourhood of 500%.

Those who have had the shares from the beginning, when they were offered 1s., can always sell if they wish and get the equivalent of 96s. for every 1s. invested, allowing for the 100% bonus issue a few years back.

Cable and Wireless Ltd., the nationalised telecommunications organisation, had quite a good year, with profits up £286,632 to £2,064,438 in the year to 31 Mar. last. Dividend also went up from 3% to 4%.

Traffic has not recovered its 1951/52 peak of 492 million words, but the 465 million words handled was 1·75% higher than in 1952/53.

Of particular interest to our industry is the chairman's statement that prospective renewals will involve considerable mileage of cable over the coming years. In the past year, revenue was not sufficient to provide for the increased cost of renewals and to pay the modest dividend. The company had to realise fixed assets and British Government and other securities to keep pace. It seems likely, therefore, that before long there will have to be a capital rearrangement with the object of raising additional capital.—*From our City Correspondent.*

Electrical Components

The improvement in the electrical side of this wholesale firm which was notable in the early months of the current financial year continued throughout the year and a large volume of television and radio business resulted from the Coronation celebrations and the enlargement of the Television reception areas so that despite increased costs the group profits have substantially increased. Mr L. E. Seccombe in his Chairman's review feels that whilst the radio and television side of the business is considerably less than 1953 with its special circumstances it is nevertheless up to expectation. The electrical side shows steady progress and prospects for the company in the current year are not disappointing.

Year to 31 Mar.	£ Trading Profit	£ Net Profit	% on Ord. Earned	% on Ord. Paid	Ord. Price High	Ord. Price Low
1950	146,879	54,067	57½	20	12/1	10/4
1951	175,867	53,711	50	20	12/6	10/6
1952	177,132	50,385	55	20	11/3	8/10
1953	141,851	44,903	45	20	12/–	9/3
1954	174,004	58,598	58	20	11/6	10/9

Escher Wyss, A. G.

Net profit of this Swiss company amounts to 763,149 francs, after dividend 5%. 150,000 francs to reserves and 288,842 francs carried forward. General expenses take Frs 7·2 m., amortisation Frs. 3.9 m., social fund contributions Frs. 1·25 m.

Hoover Ltd.

The following statement has been issued by the company (see our City Correspondent).

"The Directors are informed that there are persistent reports that a scheme of reorganisation of the share capital is under consideration on terms which would give each 'A' Share rights in excess of those attaching to each unit of Ordinary Stock.

"The Directors think it right to state, therefore, that there has been under review a scheme of re-organisation of the equity Share Capital for submission to both Ordinary and 'A' Ordinary Shareholders. There is no foundation whatsoever in the terms suggested in these current reports and should any proposals be put forward they would not result in the 'A' Shares acquiring rights more favourable than those attaching to the Ordinary Shares."

Metal Industries Ltd.

The consolidated profit of this group which controls shipbreaking, electrical and hydraulic engineering firms is £753,992, compared with £1,477,905 for the previous year. It is arrived at after the deducting of £222,805, written off by an engineering subsidiary company for block commitments in excess of current programmes. Profits of the electrical division companies (Igranic, Brookhurst Switchgear and Cantie Switches, etc.), were affected to some degree by generally less favourable conditions.

After providing £421,042 (*£858,971*) for taxation, there is a net profit of £332,950 (*£618,934*) after a subsidiary company loss attributable to outside shareholders of £10,190 (*–£6,864*) the consolidated net profit attributable to Metal Industries Ltd. is £343,140 (*£612,070*). To this is added the retained profits for previous years of subsidiary companies, to offset current losses as above, amounting to £77,294 and Parent company's profit balance brought forward £423,083 making a total of £843,517 (*£982,669*) available. Dividends take £109,038 (*£124,908*). To general reserve £150,000 (*£250,000*) plus £13,387 (*£4,404*) written-off shares in subsidiary company leaving £571,092 (*£603,357*). The directors have recommended directors' fees of £7,438 (*£8,674*) and a final dividend of 6% leaving £434,954 (*£423,038*) carry forward.

Nico Light Engineering Company

Dividend 10% and bonus 10% (*both same*) for year to 31 Mar., 1954. Net profit after tax is £8,494 (*£10,473*). To building reserve £4,000 (*nil*) forward £10,138 (*£11,598*).

Quebec Power Co.

Total revenue for year $4,859,144 ($*4,374,607*) after allowing for depreciation $475,000 ($*450,000*), bond interest $242,700 ($*245,542*) and provision for income and profits taxes net profit equals $462,539 ($*403,171*). After dividends for half year of $331,919 (*same*) surplus is $130,620 ($*71,252*). Net earnings for six months ended 30 June equals 83 c. per Common (*72 c. first half 1953*).

Shawinigan Water and Power

Net profit for first six months of 1954, $1.19 per Common share after all charges and provision for preferred dividends ($*1.2 per share*). Gross revenue from power sales was $20,227,375 and operating expenses $6,354,021. The amount of $2,938,546 was paid for power purchased. After all charges and dividends for half year on both Preferred and Common shares, surplus for period totalled $1,296,597 ($*1,148,096*).

Vactric Ltd.

The board has new ideas in hand to add to the range of the company's activities, Sir Frederick Whyte, its president, states. At the annual meeting recently, Mr W. C. Pegley, the chairman, said that the board felt that a prudently-planned capital reconstruction would be more in the interests of the shareholders than the lavish distribution of dividend.

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

23 Aug.—Derby T.C. Columns, brackets and lanterns along part of Ashbourne Rd (A.52).—Advertised in 5 Aug. issue.

23 Aug.—Lancashire. Lighting fittings and glassware for county establishments. —Advertised in 12 Aug. issue.

23 Aug.—Louth (Lincs.) R.D.C. Two electrically operated booster pumps and auxiliary equipment in Horncastle Rd station.—See 29 July issue.

23 Aug.—Sedgley U.D.C. Conversion of gas columns to electricity in class B along two roads.—See 5 Aug. issue.

23 Aug.—Spilsby (Lincs.) R.D.C.—Centrifugal pumps and ejectors for crude sewage, with electric motors, switchgear, etc. at eight pumping stations.—See 22 July issue.

23 Aug.—Stepney B.C. Lighting and power points in Cephas St and Doveton St housing scheme.—See 5 Aug. issue.

23 Aug.—Sunderland T.C. Installation in four shops and flats on Hill View estate.—See 12 Aug issue.

23 Aug.—Ventnor U.D.C. Main cables at Pier, installation of switchgear, wiring and supply electrical equipment.—See 5 Aug. issue.

23 Aug.—Wanstead and Woodford T.C. Direction signs and external lighting lanterns.—See 12 Aug. issue.

24 Aug.—Ince-in-Makerfield U.D.C. Installation in 20 houses on Battersby St site.—See 12 Aug. issue.

25 Aug.—Durham. Installation in hostel for aged people at Holmfield, Crook. Apply by above date to G. R. Clayton, County Architect, Court Lane.

25 Aug.—New Mills (Lancs.) U.D.C. Conversion of 110 gas street lamps to electricity etc.—See 22 July issue.

25 Aug.—Wandsworth B.C. Repair of about 700 time switches.—Advertised in 15 July issue.

26 Aug.—Belfast T.C. Portable fire fighting appliances.—Advertised in 5 Aug. issue.

26 Aug.—Edinburgh T.C. Electrical installation in St. Christopher's special school. City Architect, City Chambers.

27 Aug.—Bridgwater T.C. Electrically driven centrifugal pump, for Ashford Waterworks.—See 5 Aug. issue.

27 Aug.—Dublin. Heating installation at 34 Molesworth St.—See 5 Aug. issue.

27 Aug.—Leeds T.C. Electrically-driven multi-stage centrifugal pumps with electric motor and switchgear.—See 8 July issue.

27 Aug.—Leeds. Underground cables and lighting at Castle Hospital, Cottingham. —See 22 July issue.

27 Aug.—Nuneaton T.C. Sodium discharge and fluorescent mercury street lamps.—See 12 Aug. issue.

27 Aug.—Solihull T.C. Supply and installation of 64 steel columns, 140 W sodium lamps, lanterns and auxiliary gear along A.34. Borough Engineer, 90 Station Rd. Deposit £2. 2s.

28 Aug.—Midlothian. Sodium lamps on concrete columns along A70 and C29 roads.—See 12 Aug. issue.

30 Aug.—Basingstoke (Hants). Lamps in six months from 1 Oct. for Park Prewett Hospital Cttee.—See 5 Aug. issue.

30 Aug.—Coulsdon and Purley U.D.C. Installation in 92 houses in Chipstead Valley Rd.—See 12 Aug. issue.

30 Aug.—Heywood T.C. Concrete columns and equipment for class B street lighting.—See 12 Aug. issue.

30 Aug.—Kettering T.C. Supply, erection, etc., of 110 steel columns and apparatus for 400 W mercury vapour street lighting along trunk road A.6. Borough Engineer and Surveyor, 3 Gold St. Deposit £2. 2s.

30 Aug.—Leeds. Installations at Scalebor Pk Hospital, Burley-in-Wharfedale.—See 22 July issue.

30 Aug.—Litherland U.D.C. Lanterns, lamps, control gear and concrete columns for class A sodium lighting.—Advertised in 12 Aug. issue.

30 Aug.—Ramsbottom U.D.C. Concrete columns and other equipment for sodium lighting in Bridge St.—See 22 July issue.

30 Aug.—Royton U.D.C. Erection of 44 concrete columns along Heyside and Higginshaw Lane, with installation of electrical equipment. Engineer and Surveyor, Town Hall.

30 Aug.—Wrexham R.D.C. Wiring in 178 dwellings at Afoneitha, Marchwiel and Rossett—See 12 Aug. issue.

31 Aug.—Ashbourne U.D.C. Tungsten lamps with standards—stage 3 of public lighting scheme.—Advertised in 5 Aug. issue.

31 Aug.—Eastbourne T.C. Maintenance and periodic testing of air raid sirens.—See 5 Aug. issue.

31 Aug.—Ellesmere Port U.D.C. Conversion of 165 street lamps from gas to electricity. Also sodium discharge lamps along A5032.—See 12 Aug. issue.

31 Aug.—Galashiels T.C. Mercury vapour discharge lighting in Island St, Wilderhaugh and King St.—See 5 Aug. issue.

31 Aug.—Kerry (Eire) Electrical installation in new maternity unit at District Hospital, Killarney. E. Ralph Ryan, consulting engineer, 1 Mountpellier Terrace, Galway. Deposit £10. 10s.

31 Aug.—Mexborough (Yorks) U.D.C. Booster pumps with motors and switchgear.—See 5 Aug. issue.

3 Sept.—Aberdeenshire. Supply and erection of 78 80 W mercury vapour street lights, dismantling and re-erection in Aboyne. County Road Surveyor and Engineer, 4 Albyn Place, Aberdeen. Deposit £2. 2s.

3 Sept.—Co. Tyrone. Installation at Dungannon secondary intermediate schools.—See 8 July issue; closing date has been altered.

4 Sept.—Clare (Suff.) R.D.C. Wiring of 40 council houses at Wickhambrook, 8 at Stansfield, 6 at Denston, and 2 at Hawkedon. Engineer and Surveyor, Stonehall, Clare.

4 Sept.—Stamford T.C. Lighting and power points in total of 569 prewar council houses and 24 bungalows.—See 12 Aug. issue.

6 Sept.—Sandbach (Ches.) U.D.C. Installation of 82 lamp columns and lanterns of class B standard in various streets. H. J. Rees, Engineer and Surveyor, Council Offices, Crewe Rd.

6 Sept.—Wellingborough U.D.C. Columns with fluorescent lanterns for Group A street lighting.—Advertised in 12 Aug. issue.

8 Sept.—Bolton T.C. Duplicate set of electrically driven and automatically controlled booster station equipment.—See 12 Aug. issue.

8 Sept.—Luton T.C. Supply and installation or steel columns and fluorescent and sodium lighting equipment along trunk road A.6. Borough Engineer, Town Hall, Deposit £2. 2s.

10 Sept.—Belfast T.C. Supply, erection, etc., of carbon dioxide fire extinguishing equipments for substation. Tender No. W.45. Electricity Dept., East Bridge St. Deposit £2. 2s.—Advertised in this issue.

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources including an index of trade information with over 100,000 entries

A Selection from the 111 queries answered this week

Hampson Industries Ltd. as noted in the review of the Royal Show, address of? G.W.—Bull Lane, Greets Green, West Bromwich.

Rotating barbers poles, suppliers of? T.B.C.—R. Hovenden and Co., Ltd., 29 Berners St, W.1.

"Nulux" irons, makers of? E.M.B.—T. Price and Son (Stampers) Ltd., Forward Works, Spring Hill Passage, Birmingham 18.

"Aarcon" air conditioning units, address for? S.E.B.—Air Conditioning and Refrigeration, c/o Barclays Bank, 29 Gracechurch St, E.C.3.

"Simplifix" Con type pipe unions, makers of? E.E.B.—Simplifix Couplings Ltd., 157 Victoria St, S.W.1.

"Empire" trouser press, makers of? G.A.H.—Lighters Ltd., Pioneer House, Inverness Rd, Hounslow.

Small ovens for food with infra-red heating, makers of? S. Worne, 17 High St, Egham, Surrey.

10 Sept.—Eire. Electrical installation in proposed dispensary and clinic at Blackrock. Consulting Engineers, P. H. McCarthy and Son, 26 Lr. Leeson St, Dublin. Deposit £5. 5s.

11 Sept.—Newmarket U.D.C. Supply and installation of 16 Group A mercury vapour street lighting units with control gear, lamps, concrete columns, and 4 Group B tungsten units with enclosed lanterns and concrete columns. F. B. Waterfall, Engineer and Surveyor, Council Offices, Severals Hse. Deposit £1. 1s.

13 Sept.—Dublin T.C. Installation in Technical School for Girls in Crumlin Rd.—See 29 July issue.

13 Sept.—Middlesex. Supply of electric lamps for year ending 31 Oct., 1955. Chief Supplies Officer, 245 Acton Lane, N.W.10.

13 Sept.—Peterlee (Dur.). Electrical installation in 310 houses on Acre Rigg sites. A. V. Williams, general manager of Development Corpn., Shotton Hall, Castle Eden, Co. Durham.

16 Sept.—Belfast T.C. Metering equipment.—Advertised in 12 Aug. issue.

17 Sept.—Sheffield T.C. Electrical installation in 132 dwellings on Greenhill-Bradway estate. Apply by 28 Aug. to J. L. Walmersley, City Architect, Town Hall. Deposit £2.

17 Sept.—Wortley R.D.C. Class A street lights at Chapeltown, nr. Sheffield.—See 12 Aug. issue.

18 Sept.—Burton-on-Trent T.C. Equipment for three street lighting schemes: group B lighting comprising 126 150 W tungsten lanterns with concrete columns; group A lighting consisting of 63 3 × 80 W fluorescent lamps and columns; and group A lighting comprising 70 140 W sodium discharge lamps and columns. Borough Surveyor, Town Hall.—Advertised in this issue.

20 Sept.—Lancashire. Wireless equipment for ambulance service.—See 12 Aug. issue.

27 Sept.—Plympton (Dev.) R.D.C. Seven sets electrically driven vertical unchokeable sewage pumps with auxiliary equipment. John Taylor and Sons, Artillery Hse, Artillery Row, Westminster. Deposit £5.

No date stated—N. of Scotland H. E. Board. Construction of 11 kV and l.v. wood pole lines.—Advertised in 12 Aug. issue.

No date stated—N. of Scotland H.E. Board. Outdoor 33 kV switchgear, etc., for Fort William substation.—Advertised in 12 Aug. issue.

No date stated—N. of Scotland H.E. Board. Lighting, heating, etc., for Finlarig power station.—Advertised in 12 Aug. issue.

. . . and Overseas

Details of items marked * may be obtained on application to the Board of Trade, Lacon House, Theobalds Rd, W.C.1, quoting reference.

2 Sept.—India. Supply of insulators and accessories for Electricity Dept, Govt. of Andhra. Specification A.94. Also Damoder Valley Corpn. invite tenders (Specif. ED.718/1) for control panels for Maithon Left and Right Bank sub-stations;—documents Rs.10 per copy. B.o.T. (Refs.: ESB 19377/54 and ESB 19365/54 resp).*

2 Sept.—South Africa. Stores Dept., S. African Railways require 6,000 ft 4-core 660 V grade PILC and S cable. Tender No. C.8020. B.o.T. (Ref.: ESB 19126/54)*

8 Sept.—Australia. State Electricity Commission of Victoria invites tenders (No. 54-55/23) for supply of various low voltage switchgear. Prelim. deposit of £10 required. B.o.T. (Ref.: ESB 19351/54)*

8 Sept.—South Africa. Tenders (C.8176) invited for supply of 18,000 wedges for armature coils. Chief Stores Superintendent, S. African Railways, P.O. Box 8617, Johannesburg. B.o.T. Ref.: ESB 19275/54)*

10 Sept.—New Zealand. Supply of 3,500 yd of 3-core paper insulated cable and 16 straight-through cable boxes. Auckland Electric Power Board, Queen St, Auckland. Deposit £100 required. B.o.T. (Ref.: ESB 19361/54)*

25 Sept.—Persia. Supply of two turbo-generators with boilers and spares; and installation at Veramin Vegetable Oil Extraction Plant. Chemical Products Co., Tehran. B.o.T. (Ref.: ESB 18797/54)*

29 Sept.—New Zealand. Stores Div., G.P.O., Wellington, invites tenders (P and T 150/7214) for supply of 25,000 protectors and fuses. B.o.T. (Ref.: ESB 19297/54).*

29 Sept.—New Zealand. Supply of total of 135 rotary switches, break before make action, for transformer tap switching. Tender No. P. and T. 150/7221. Post and Telegraph Dept, Wellington. B.o.T. (Ref.: ESB 19084/54).*

22 Oct.—Argentina. Construction of h.t. line to carry current from power station to two towns about 244 kilometres distant, Tenders (No. 110/54) invited by Ministry of Industry and Commerce. Project to cost about £1,200,000, comprising £310,000 of steel cored aluminium cable, etc., £60,000 insulators, £20,000 steel cables and £810,000 transformers and sub-station equipment. Closing date was 7 Sept. originally. B.o.T. (Ref.: ESB 17097/54).*

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, 17 August

	£ per ton	Weekly change £	Price last year £
COPPER, standard class A (settlement)	235½	+1½	232½
„ (3 months)	233½	+1½	215½
LEAD, refined pig, min. 99·97% purity (cash)	97½	+½	96
„ (3 months)	94½	+½	89½
TIN, refined, min. 99·75% purity (settlement)	731	+4	618½
„ (3 months)	731	+5	614½
ALUMINIUM, ingots 99-99·5%	156	—	150
ZINC, virgin, min. 98% purity (cash)	74⅞	+⅛	73½
„ (3 months)	75	+⅛	73$\frac{15}{16}$
RUBBER No 1, RSS. spot (per lb.)	20½d	−$\frac{1}{16}$d.	19$\frac{15}{16}$d.
„ c.i.f. basis, ports. Oct. (per lb.)	19$\frac{15}{16}$d.	−$\frac{1}{16}$d.	19½d.
ARMOURING:			
Galv. Steel Wire (0·104 in.)	52	—	50½
Mild Steel Tape (0·014 in.)	40½	—	40

Contracts Placed

Durham. Rewiring at Cambridge Hse, Hostel, N. of England Engineering and Electrical Co., Ltd, £2,301.

Ilkeston T.C. Supply of 87 class A street lamps and 40 class B lamps, E. Midlands Electricity Board, £4,222.

Norton-Radstock (Som.). U.D.C. Conversion of gas street lighting to 60 W sodium lamps, 298 units, S.W. Electricity Board, £13,164.

Gazette Announcements

Hattons (Billingham) Ltd. Meetings of creditors and contributories to be held tomorrow (20 Aug.) at Official Receiver's Office, 4 Bridge Rd, Nottingham, at 11 a.m. and 11.30 a.m. resp.

Edolite Lamps Ltd. A. T. Eaves of 47 Mosley St, Manchester, has been appointed liquidator with committee of inspection.

Wm. Hodgkins and Co., Ltd. Resolution for voluntary winding-up passed at meeting on 30 July. Creditors have appointed E. E. V. Rowley, 20 Friar Lane, Leicester, and R. A. Haigh, Court Chambers, Friar Lane, Leicester, as liquidators.

Winstanley (Decorations) Ltd. At meeting on 29 July resolution passed for voluntary winding-up. Creditors subsequently appointed R. Langdon Davis, Bedford Row Hse, 58 Theobalds Rd, W.C.1, as liquidator.

COMPANIES ACTS

S.R.M. Television Ltd. Meetings of creditors and contributories will take place on 26 Aug. at Official Receiver's office, 27 Regent St, Park Row, Nottingham, at 11 a.m. and 11.30 a.m. resp.

Articair Refrigeration Ltd. Meetings of creditors and contributories have been arranged for 25 Aug. at Inveresk Hse (Room 401), Strand, London, W.C.2, at 11.30 a.m. and 12 noon resp.

County Electronics Ltd. Meetings of members and creditors will taken place at offices of Harry L. Price and Co., 47 Mosley St, Manchester, on 27 Aug. at 3 p.m. and 3.15 p.m. resp. to receive liquadators' report.

Smith and Forshaw Ltd. Resolution for winding-up passed at meeting on 30 July, and John G. Beaumont, 32-33 Commercial St, Leeds, was appointed liquidator.

BANKRUPTCY ACTS

Intended Dividend

Exeter. Robert J. Camden, electrical engineer trading at 31 New Bridge St, Exeter. Last day for receiving proofs, 28 Aug. Trustee is G. C. Ehlers, 28 Baldwin St, Bristol.

Receiving Order

Leicester. Frederick Monk, electrical and radio engineer of Ashley Rd, Stapleton. Receiving order dated 6 Aug.

Intended Dividends

Gt. Grimsby. Brian T. Smith, electrical engineer and contractor trading at The Studio, Ramsgate, Louth. Last day for receiving order, 31 Aug. Trustee is L. F. McCullock, 26 South St. Mary's Gate, Grimsby.

BUSINESS PROSPECTS

Home

Ayr. Plans submitted for new police stations at Mauchline, Dalry, Maybole and New Cumnock.

Barnstaple. Showroom to be built in Diamond St. for Bale's Garage Ltd.

Bexley (Kent). Covered swimming bath at Crook Log estimated to cost £120,000.

Blackpool. Presbyterian church to be built at Layton. Architects are Fairbrother, Hall and Hedges, 2 Birley St.

Bray (Wicklow). Portland Glass Co., London, W.1, are to build factory at St. Angelo's Field, Boghall Rd.

Bridgnorth R.D.C. Construction of 60 houses at Highley and 6 at Endon George. G. C. Harris, clerk of council, Westgate, Bridgnorth.

Burgess Hill (Sus.) U.D.C. Erection approved of 56 houses in Royal George Rd.

Co. Tyrone. Approval given to erection of Dungannon secondary intermediate schools, Strabane grammar school, and extensions to Coalisland primary school.

Dartford T.C. Erection of 60 dwellings on Temple Hill Neighbourhood Unit. Borough Surveyor, Barclays Bank Chambers, High St.

Derbyshire. Next year's building programme includes following schools: Whittington secondary modern, Chesterfield (£93,500); Duffield grammar (£112,200); Ripley secondary technical (£70,000); Hill Top junior, Breadsall (£51,392); Spondon grammar (£168,300); Hallam Fields infants, Ilkeston (£29,887); Bannerlay secondary modern, Ilkeston (£44,000); Creswell secondary modern (£95,232); Birley grammar, (£168,300); and Ashbourne primary (£30,154). Secondary technical school proposed at Beighton.

Dungannon U.D.C. Fifty-six houses to be built by N. Ireland Housing Trust on Donaghmore Rd site.

Durham. Approval given to proposals to install electricity in following schools: Houghton-le-Spring grammar (£2,700); Cockfield C.E. controlled (£490); Cornsay Colliery county (£475); Easington Lane R.C. Aided (£450); Murton R.C. Aided (£550); Edmondsley county (£650); Hebburn R.C. Aided (£1,500); Long Newton C.E. controlled (£150); Murton Colliery county (£581); Page Bank county (£150); Seaham Harbour Deneside county (£2,250); Sedgefield county (£900); Trimdon Grange county (£900); and Annfield Plain secondary modern (£2,150).

Eastbourne. T.C. recommended to approve plans for new Winter Garden Building to cost £265,000. Architects are Easton and Robertson, 5 Bedford Sq, W.C.1.

East Farleigh (Kent). It is proposed to build county primary school at estimated cost of £30,000.

Gainsborough U.D.C. Erection of 24 houses off White's Wood Lane. Engineer and Surveyor, Council Offices, 6 Lord St.

Halifax T.C. Erection of block of shops and flats in Bank Edge Rd, Ovenden. Borough Engineer, Crossley St.

Hamilton T.C. Dean of Guild Court has approved erection of 92 houses in Neilsland Rd.; and also (for Scottish Special Housing Assoc.) 68 houses in Burnbank Rd.

Haslingden (Lancs.). Durie and Miller Ltd., Farholme Mill, Stacksteads, Bacup, to build new factory costing about £150,000.

Hayes and Harlington U.D.C. Construction of 60 flats (first phase of 134) on Watery Lane estate. Engineer and Surveyor, Town Hall, Hayes, Middx.

London. Scheme approved for erection of 440 flats near Golden Lane estate.

Maidstone. Scheme in hand for erection of fire station in Loose Rd. Estimated cost £64,000.

Manchester. Application to be made to borrow £198,811 for first instalment of Irwell Further Education College.

Middlesbrough. Loan sanction received for £181,058 for additions to Constantine technical college; and £153,482 for proposed Middle Beck No. 2 county secondary modern school.

Newcastle-on-Tyne. Work to start next Jan. on conversion of Walkergate Hospital into an eye hospital.

Northumberland. Proposals for electrical work at following county primary schools approved: Annisford (£334); Forest Hall (£660); Lynemouth (£325); Alnwick (£257); East Ord (£168); and Hartburn (£165).

Northumberland. Preliminary plans submitted for Longbenton county primary school. Cost estimated at £108,000.

Norton-Radstock (Som.) U.D.C. Permission granted for 90 houses and 27 bungalows on Hillside Ave estate.

Peterborough T.C. Two new estates comprising 460 houses are proposed in Paston—Gunthorpe area.

Renfrew. £89,560 to be borrowed to build 60 houses at Linwood.

Rochdale. Approval in principle given to installation of new electrical distribution system at Birch Hill Hospital.

Richmond (Yorks) R.D.C. Swale Hse, in Station Bank, to be bought and converted into council offices.

Truro T.C. Erection of 29 houses on Malabar scheme. City Engineer and Surveyor, Municipal Buildings.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Autronic. 727,551. Class 9. Thermionic valves. Plessey Co., Ltd., 56 Vicarage Lane, Ilford, Essex.

Seglarm. 730,318. Class 9. Electro acoustic alarms for attachment to bags, cases and the like. A. H. Kisch, 11 Regency Sq, Brighton 1.

Trimon. 727,800. Class 9. Thermostats, thermostatic valves, switches, pilot controls, etc. Monitor Eng and Oil Appliances Ltd., Monitor Works, Flaxley Rd, Stetchford, Birmingham 33.

"Guardaloy." 729,073. Class 9. Anodes, terminal connectors for making connections to pipes etc. for use in the cathodic protection of metallic structures against corrosion. F. A. Hughes and Co., Ltd., Devonshire Hse, Mayfair Place, Piccadilly, W.1.

Educorder. 729,312. Class 9. Apparatus for recording, reproducing and amplifying electric oscillations. Wright and Weare Ltd., 131 Sloane St, S.W.1.

Frequistor. 730,320. Class 9. Resistances and apparatus incorporating resistances. Belling and Lee Ltd., Gt Cambridge Rd, Enfield, Middx.

Caora. B728,587. Class 9. Heated pads and blankets. Michael Platt, Underbank Hall, Charlestown, Hebden Bridge, Yorks.

Bel-stat. 729,934. Class 9. Heated blankets and pads. Belmont Mfg Co, 7 James St South, Belfast.

Infray. 730,115. Class 9. Heating and lighting appliances. Electronic Precision Equipment Ltd, Bourne Hse, Grove Rd, Eastbourne.

TRADE NOTES

Change of address. New address of Ductube Co., Ltd, is 1 Adelaide St, Strand, London, W.C.2. Tel.: Covent Garden 1156/7/8.

The Kersons Manufacturing Co., Ltd's new address is Wayland Works, Kings Rd, Tyseley, Birmingham 11. Tel: Acocks Green 0616/7/8.

Trade Mark Change. Winston Electronics Ltd. have discontinued use of Trade Mark "Voltastat." Instead "Constavolt" will be used when stabilising voltage control equipment is designed for battery charging, etc., and "Hagnetrol" when used for rectification, battery elimination, etc.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons, Ltd., 116 Chancery Lane, W.C.2.

Shimwell Alexander Manufacturing Ltd. 20 Dock St, Stepney, E.1. Manufacturers of and dealers in electrical and mechanical apparatus, accessories and components, electric motors, etc. Nom. cap.: £5,000. Dirs.: N. B. Mackay, J. A. Shimwell, Mrs E. F. Mackay and Mrs F. M. Shimwell.

Telefridge Service Ltd. 193 Mare St, Hackney, E.8. To take over business of radio, television and electrical goods dealers, carried on at Hackney, E.8, as "Telefridge Service" by Sidney and Olive Gold. Nom. cap.: £2,000. Dirs.: S. Gold and Mrs O. Gold.

Regulite Electrical Co., Ltd. 40 Hillersdon Ave, Barnes, S.W.13. Nom. cap: £200. Dirs.: Comdr. H. Pursey, R.N., and Florence M. M. Vanek.

A. Oberman Ltd. Electrical engineers and contractors, etc. Nom. cap.: £100. Dir.: A. Oberman, 33 Durlston Rd, E.5.

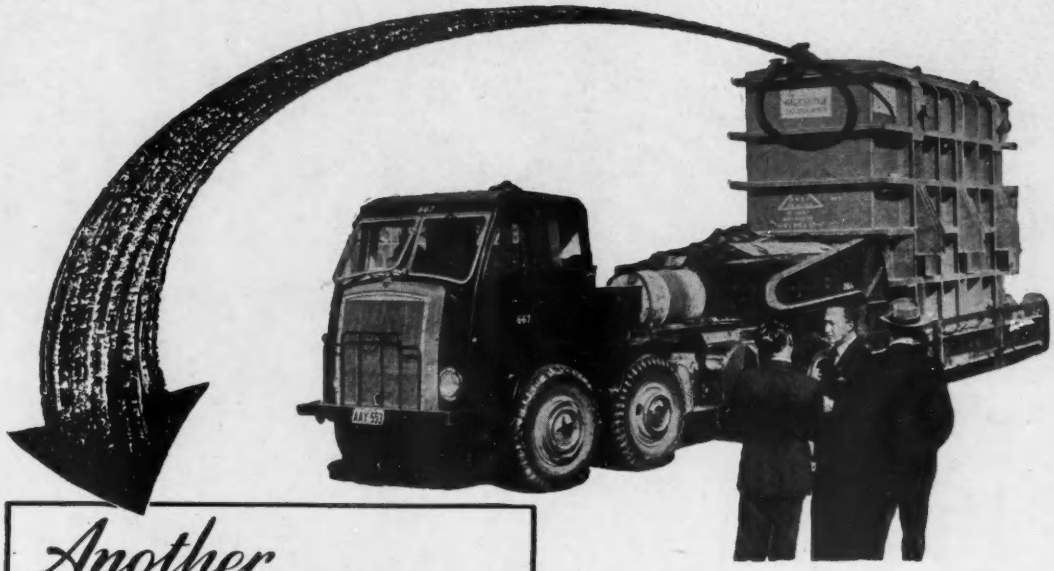
H. N. Electrical (Engineering) Ltd. 4 Brixton Hill Place, S.W.2. Nom. cap.: £100. Dirs.: G. G. Bachelier, A. L. Maizner and H. Nathan.

Paul Taylor and Partners Ltd. 1 Silver St, Kettering. Manufacturers of and dealers in radio and television apparatus, etc. Nom. cap.: £5,000. Life dirs: H. P. Taylor and Mrs D. M. Taylor.

A. E. Connorton (Engineers) Ltd. Bristol Hse, 19/20 Holborn Viaduct, E.C.1. General, heating, ventilating, lighting, electrical and mechanical engineers, etc. Nom. cap.: £100. Dir.: A. E. Connorton.

Knox Schlapp (London) Ltd. 3 St. James' Sq, S.W.1. Agents, factors, dealers, contractors, builders, mechanical and electrical engineers, etc. Nom. cap.: £2,000. Dirs.: C. A. Soutar and W. A. C. Brough.

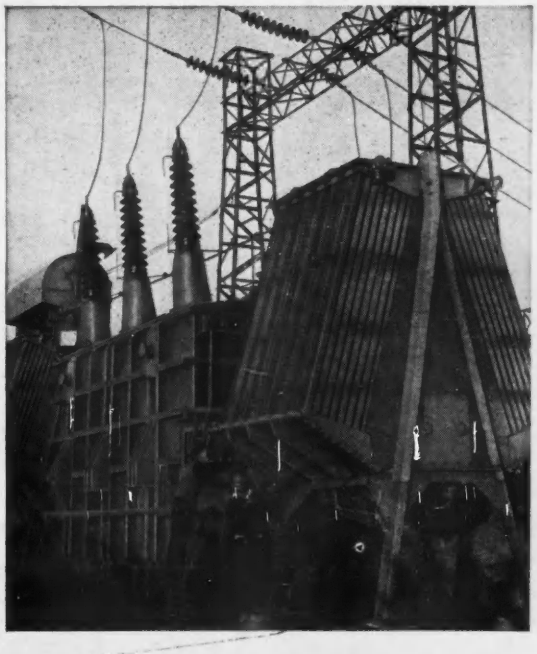
H. H. Electrical (London) Ltd. 37 Manchester St, W.1. Electrical equipment specialists, etc. Nom. Cap.: £100. Dirs.: Mrs R. Herzog and J. C. Clarke.



Another HACKBRIDGE TRANSFORMER FOR SERVICE OVERSEAS

MONTH after month large Hackbridge transformers leave the Works for destinations extending to the most distant parts of the world. The illustrations show the arrival and installation of one of five 30,000 kVA 132/33 kV type ON/OB Hackbridge transformers for the Electricity Commission of New South Wales.

Over 18 million kVA of Hackbridge transformers have been manufactured, including some of the world's largest units.



HACKBRIDGE TRANSFORMERS

Made in Britain by

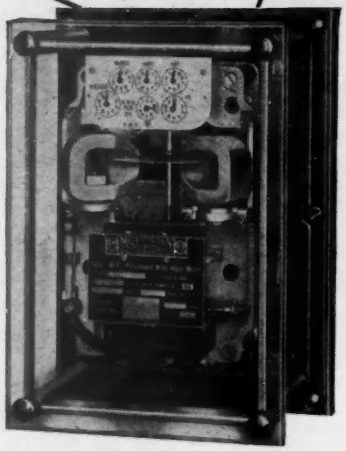
HACKBRIDGE AND HEWITTIC ELECTRIC CO., LIMITED
WALTON-ON-THAMES - SURREY - ENGLAND
Telephone: Walton-on-Thames 760 (8 lines) *Telegrams: "Electric, Walton-on-Thames"*

Metrovick Metering Means Trouble-free Accounts

Type NE4 Three-element Polyphase Watt-hour Meters are designed to provide accurate performance up to one-and-a-half times full load.

- Accuracy not significantly affected by normal variations in voltage, frequency, wave form or temperature.
- 3 patterns—house-service, semi-switchboard and full-switchboard.
- Adjustments quickly and easily made.
- Fulfils requirements of BS 37.

Type NE4 Maximum Demand and kVArh Meters also available

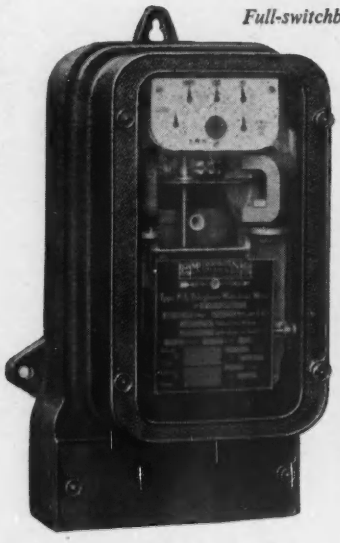


Full-switchboard Pattern

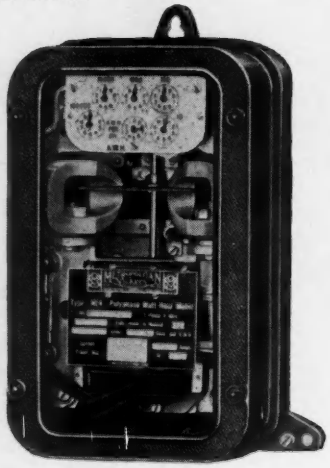
TYPE NE4

POLYPHASE WATT-HOUR METER

for 3-phase 4-wire circuits up to 375 volts (phase to neutral). Self-contained up to 50 amps.



House-service Pattern



Semi-switchboard Pattern

METROPOLITAN-VICKERS
ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER, 17

Member of the AEI group of companies

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CLASSIFIED ADVERTISEMENTS

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 32s. 6d. per inch, and all other classified advertisements at 2s. 6d. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

TENDERS INVITED

COUNTY BOROUGH OF BURTON UPON TRENT

STREET LIGHTING

THE Corporation invite tenders for the carrying out of the following works within the County Borough of Burton upon Trent:

Scheme 1.—Group "B" Street Lighting consisting of 126 No. 150 W Tungsten lanterns together with concrete columns.

Scheme 2.—Group "A" Street Lighting consisting of 63 No. 3 x 80 W Fluorescent lamps and columns.

Scheme 3.—Group "A" Street Lighting consisting of 70 No. 140 W Sodium discharge lamps and columns.

Conditions of Contract, Specifications and Forms of Tender may be obtained on application to the Borough Surveyor, Town Hall, Burton upon Trent, and plans showing locations of the lamps may be inspected during normal office hours at the office of the Borough Surveyor.

Sealed tenders, in envelopes to be provided, must be delivered to the undersigned not later than 10 a.m. on Saturday, 18 Sept., 1954.

The acceptance of a tender or tenders will be subject to the Standing Orders of the Council with respect to Contracts (a copy of which may be obtained on application to the Borough Surveyor) and to the execution of a formal Contract.

The Council do not bind themselves to accept the lowest or any tender, and reserve the right to accept separate tenders for the three schemes.

H. BAILEY CHAPMAN,
Town Clerk.

Town Hall,
Burton upon Trent.
18 Aug., 1954. (K 735)

CITY OF BELFAST

FIRE EXTINGUISHING EQUIPMENTS

TENDERS are invited for the supply, delivery and erection of carbon dioxide fire extinguishing equipments for Electrical Substations.

Form of Tender and Specification (No. W.45) may be obtained at the Electricity Department, East Bridge St, Belfast, on payment of a deposit of two guineas which will be refunded provided a bona fide Tender is lodged and not withdrawn. Extra copies may be obtained at one guinea each; this sum will not be returnable. Cheques should be made payable to the Belfast Corporation Electricity Department.

Each Tender, in sealed envelope marked "Tender for Carbon Dioxide Fire Extinguishing Equipments, Electricity Committee," and endorsed with the name and address of the tenderer, must reach the undersigned not later than 4 p.m. on Friday, 10 Sept., 1954.

An official receipt must be obtained for each Tender delivered by hand. Tenders sent by post should be registered.

The lowest or any Tender will not necessarily be accepted.

continued in next column

continued from previous column

JOHN DUNLOP,
Town Clerk.

City Hall, Belfast,
P.O. Box 234.
12 Aug., 1954. (K 762)

APPOINTMENTS VACANT

Engagement of persons must be made through a Local Labour Office or Scheduled Employment Agency, if the applicant is a man aged 18-64, or a woman aged 18-59; unless the person concerned is excepted or the employment is in a managerial or professional capacity, or is otherwise excepted from the provisions of the Notification of Vacancies Order, 1952.

BRITISH ELECTRICITY AUTHORITY
East Midlands Division

APPLICATIONS are invited for the following position within the Division:

THIRD ASSISTANT ENGINEER, TRANSMISSION CONSTRUCTION DEPT. (OVERHEAD LINES) DIVISIONAL HEADQUARTERS
Vacancy No. 121/54/ET

Preference will be given to applicants who are corporate members of either the Institution of Civil, Electrical or Mechanical Engineers, or who hold equivalent qualifications and have had experience in construction of E.H.T. Transmission lines in the field from initial profile to final sag checking.

The salary will be within Schedule C, Class AX/DX, Grade 5 (£649/£858 per annum), of the National Joint Board Agreement.

Closing date for receipt of applications, 26 Aug., 1954.

This appointment will be pensionable within the terms and provisions of the British Electricity Authority and Area Boards Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT which may be obtained from the Divisional Establishments Officer, British Electricity Authority, P.O. Box 25, Barker Gate, Nottingham, and should be returned to the undersigned by the date stated. Please quote Vacancy Number.

L. F. JEFFREY,
Divisional Controller.
13.8.54. (K 742)

THE SOUTH WALES ELECTRICITY BOARD

APPLICATIONS invited for positions of COMMERCIAL ASSISTANT in the following districts of the Western Sub-Area:

District 104—Lampeter
District 105—Llandilo

Applicants must have had experience in the application of electricity to domestic and commercial premises and all general purposes.

Salary—Class C, Grade 10 (£502/£512/£521) of N.J.B. Schedule.

Applications stating age, present position and salary, qualifications, experience and three referees, to be addressed to the Secretary to arrive by 28 Aug., 1954.

Previous applicants need not re-apply.

D. G. DODDS,
Secretary.
St. Mellons,
Cardiff. (K 697)

BRITISH ELECTRICITY AUTHORITY
London Division

APPLICATIONS are invited for the following superannuable posts. Conditions of service in accordance with N.J.B. Agreement, Schedule A. Salary includes London Allowance. Qualifications entitling to Graduate Membership of the I.E.E. or I.Mech.E. an advantage.

INSTRUMENT ENGINEER—FULHAM GENERATING STATION
Vacancy No. 54/665

Applicants should have received a sound technical training and duties will cover maintenance, calibration and repair of Boiler House and Turbine House instruments for steam and water flows, and general instruments. Salary—Class L, Grade 12=£700. 7s. p.a.

ASSISTANT ENGINEER (TECHNICAL)—LOMBARD ROAD GENERATING STATION
Vacancy No. 54/666

Applicants should have received a sound technical training and should be conversant with the preparation of routine Operating Returns, and preferably have some knowledge of instrument maintenance. Salary—Class F, Grade 12=£532. 7s. p.a.

SHIFT CHARGE ENGINEER—LOMBARD ROAD GENERATING STATION
Vacancy No. 54/667

Applicants should have a sound technical education with experience in operation of Boiler House and Turbine Room plant. Salary—Class F, Grade 7=£731. 17s. p.a.

SHIFT CHARGE ENGINEER—ST. PANCRAS GENERATING STATION
Vacancy No. 54/668

Practical experience in efficient operation of medium pressure turbine and boiler plant, also E.H.T. switchgear. Character and ability to supervise all grades essential. Salary—Class E, Grade 7=£681. 9s. p.a.

Application, quoting vacancy number, may be made on the form obtainable from Divisional Secretary, British Electricity Authority, London Division, P.O. Box 136, Generation House, Great Portland St, W.1, and be received within 14 days of this advertisement. (K 731)

SOUTH EAST SCOTLAND ELECTRICITY BOARD

JOINTER E.H.T. wanted for Berwick District, Southern Sub-Area. N.J.I.C. Conditions. Present rate of pay 45 pence per hour. To reside in Berwick upon Tweed where a Council house will be made available to the successful applicant on taking up the post. Applications stating age, whether married or single, and giving details of training and experience should reach the Sub-Area Manager, South East Scotland Electricity Board, High Street, Galashiels, within 14 days. (K 699)

NOTTINGHAM AND DISTRICT TECHNICAL COLLEGE

Principal: H. Baker, PH.D., A.M.I.C.E., A.M.I.MECH.E.

APPLICATIONS are invited for the post of ASSISTANT LECTURER, GRADE A, IN ELECTRICAL ENGINEERING. A recognised qualification such as the Higher National Certificate, is desired and preference will be given to candidates having wide industrial experience. The teaching will include general electrical subjects to Ordinary National Certificate level and, if possible, craft subjects to the level of the Intermediate City and Guilds. In the case of a suitable applicant, some teaching at higher levels can be included if desired.

Salary scale £450 x £18—£725 per annum, with a further £60 for graduate or equivalent qualification and up to 3 increments of £18 each for approved periods of training. Regard may be paid to approved industrial experience when assessing the commencing salary.

Further particulars and forms of application may be obtained from the Registrar, Nottingham and District Technical College, Shakespeare St, Nottingham, and should be returned to him not later than 31 Aug., 1954.

F. STEPHENSON,
Clerk to the Joint
Education Committee.
10.8.54. (K 706)

STATION ENGINEERS AND STATION ENGINEERS (MECH).

required by Air Ministry at R.A.F. and M.C.A. stations. Qualifications and exp. reqd.: (*a*) Ordinary National Certificate in either Electrical of Mechanical Engineering as appropriate or equivalent standard of technical education. (*b*) Recognised apprenticeship in either electrical and/or mechanical engineering. (*c*) Three years responsible engineering employment, preferably on operation and maintenance of mine, factory or workshop plant and services. Supervisory and cover installation, operation and maintenance of high and medium voltage distribution system, internal electrical installations, diesel and boiler house plant, steam and hot water heating systems and other miscellaneous installations, tools and equipment. Station Engineers (Mech.) duties are of more specialist nature and cover mechanical items only. Commencing salary according to age, qualifications and experience (normally £550 at age 28 or over), on the range £510/£640. Appointments include liability for service overseas for which special allowance payable in addition to higher salary. Appointments non-pensionable. Only natural born British subjects. Write giving date of birth, education, full details of qualifications and experience of posts held (including dates) to E.A.1564, Appointments Officer, Ministry of Labour and National Service, 1-6 Tavistock Sq, W.C.1, by 4 Sept., 1954. No original testimonials should be sent. Only candidates selected for interview will be advised.
(K 734)

YORKSHIRE ELECTRICITY BOARD

No. 3 (Sheffield) Sub-Area

Rotherham/Mexborough District

DISTRICT COMMERCIAL ENGINEER

APPLICANTS must be conversant with all matters connected with the commercial organisation of an electricity supply undertaking in a district consisting of a heavy industrial and densely developed residential area surrounded by a rural area.

Experience in negotiations with large power consumers, load development, electrical contracting, preparation of statistics and reports; organisation of consumers' records and the control of staff will be an advantage.

Preference will be given to candidates who are corporate members of the I.E.E. The successful candidate will be required to live in the district.

Salary—N.J.B. Class J, Grade 4, £1,026/£1,071 per annum.

Sub-Area Headquarters

GENERAL ASSISTANT ENGINEER (CIVIL)

Applicants should possess the Higher National Certificate in Civil Engineering, and must be fitted by training and experience for the supervision of civil works on site by direct labour and to act as Clerk of Works where the work is carried out by contract.

Specialised experience in the construction of large electricity substations will be an advantage.

Salary—N.J.B. Class N, Grade 13, £692/£716 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 3 (Sheffield), Sub-Area, Yorkshire Electricity Board, Commercial St, Sheffield, not later than 3 Sept., 1954.

No. 1 (Bradford) Sub-Area

THIRD ASSISTANT ENGINEER (CONSTRUCTION AND MAINTENANCE)

Applicants should be corporate members of the Institution of Electrical Engineers or hold other acceptable technical qualifications, and should have good experience in the construction and maintenance of extensive complete overhead and underground systems operating at voltages up to 66 kV. The post involves participation in standby duties.

Salary—N.J.B. Class K, Grade 10, £719/£750 per annum.

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Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 1 (Bradford), Sub-Area, Yorkshire Electricity Board, 45-53 Sunbridge Rd, Bradford, not later than 3 Sept., 1954.

No. 6 (Hull) Sub-Area

Goole District

THIRD ASSISTANT DISTRICT ENGINEER (Pocklington)

Applicants should hold the Higher National Certificate in Electrical Engineering or equivalent qualifications, and have had experience in the construction, operation and maintenance of E.H.T. and L.T. overhead and underground distribution systems in a rural district.

The successful applicant will be required to reside in Pocklington and undertake standby duty.

Salary—N.J.B. Class E. Grade 9, £587/£600 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 6 (Hull), Sub-Area, Yorkshire Electricity Board, Ferensway, Hull, not later than 3 Sept., 1954.

No. 5 (Wakefield) Sub-Area

Wakefield District

GENERAL ASSISTANT DISTRICT ENGINEER

Applicants must have had a sound practical training with experience in the construction, operation and maintenance of H.V. and M.V. overhead and underground distribution networks, substation plant and ancillary equipment.

Applicants must hold a current driving licence, be prepared to reside in the district and undertake standby duties.

Applicants must hold at least a Higher National Certificate in Electrical Engineering.

Salary—N.J.B. Class F, Grade 11, £548/£565 per annum.

Sub-Area Headquarters

ENGINEERING DRAUGHTSMAN SURVEYOR

Applicants must be able to undertake the preparation of final and working drawings connected with the erection and equipment of substations and must have a sound knowledge of industrial and commercial building construction. They must have had experience in the use of surveying instruments and in site survey.

Salary—N.J.B. Schedule D, Grade 6, £433/£567 per annum. Entry to the grade will be in accordance with capabilities and experience.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 5 (Wakefield), Sub-Area, Yorkshire Electricity Board, 1a Denby Dale Rd, Wakefield, not later than 3 Sept., 1954. (K 724)

BRITISH ELECTRICITY AUTHORITY

Southern Division

require a DIVISIONAL TECHNICAL ENGINEER. Candidates should preferably be Corporate Members of the Institute of Electrical Engineers and have had wide experience of electro-technical matters including system development, testing and commissioning of electrical plant and equipment including switchgear and transformers and also protective, metering and telecommunications equipment. The successful candidate will be required to exercise administrative control over the Technical Department at Divisional Headquarters, Portsmouth, and be responsible to the Divisional Controller.

Applicants should preferably have held previous positions of responsibility giving experience in all sections referred to.

Salary within N.J.M. Scale 4, £1,600/£1,750.

Applications stating age, present position and salary, full details of qualifications and experience to D. Moffat, Director of Establishments, Winsley St, London, W.1, by 4 Sept., 1954. Quote, Ref. ET/505. (K 710)

BRITISH ELECTRICITY AUTHORITY

North West, Merseyside and N. Wales Division

VACANCY No. 143/54—STATION SHIFT CONTROL ENGINEER, Huncoat Generating Station, near Accrington. Salary £577/£598 (F.10).

Vacancy No. 148/54—STATION SHIFT CONTROL ENGINEER, Westwood Generating Station, near Wigan. Salary £608/£630 (G.10).

Apply, quoting Vacancy No. to Controller, British Electricity House, 825 Wilmslow Rd, Manchester 20, before 28 Aug.
(K 726)

THE NORTH WESTERN ELECTRICITY BOARD

APPOINTMENT OF JUNIOR ENGINEERS (TESTING ASSISTANTS) TESTING STATIONS, ARDWICK AND SALFORD

APPLICANTS should have had experience of testing metering or protective equipment and should hold the O.N.C. in Electrical Engineering.

Salary Scale: £402/£544 p.a. Grade N.22/18. N.J.B. Conditions.

APPOINTMENT OF GENERAL ASSISTANT DISTRICT ENGINEER—EAST DISTRICT, CHORLTON-ON-MEDLOCK

The duties will include assistance on substation construction, maintenance and operation and the keeping of the necessary records, but the duties will not be restricted to this class of work. Applicants should have received technical training to H.N.C. level, and should have had practical experience on substation work, operation, cable laying and jointing, etc. Corporate membership of the Institution of Electrical Engineers will be an advantage.

Salary Scale: £573/£596 p.a. Grade G.11. N.J.B. Conditions.

Applications for the above posts to Sub-Area Secretary, No. 1 Sub-Area, The North Western Electricity Board, Town Hall, Manchester, P.O. Box 493, by 28 Aug., 1954.

APPOINTMENT OF ENGINEERING DRAUGHTSMAN—NORTH-WEST FYLDE DISTRICT, FLEETWOOD

Applicants should preferably have experience in the preparation of plans for new and existing buildings, electrical network diagrams and layout and construction of substations. The possession of a Technical Certificate in Electrical or Mechanical Engineering will be an advantage.

Salary Scale: £433/£567 p.a., Schedule D, Grade 6. N.J.B. Conditions.

Applications to Sub-Area Manager, No. 4 Sub-Area, The North Western Electricity Board, 40/41, Lune St, Preston, by 28 Aug., 1954.

APPOINTMENT OF GENERAL ASSISTANT ENGINEER (METERS AND PROTECTION) SUB-AREA ENGINEER'S DEPARTMENT, CARLISLE

The successful applicant will be required to carry out general testing duties in a Class "A" Testing Station. Some knowledge of the testing and routine maintenance of protective gear and the use of high voltage pressure testing equipment is necessary.

Salary Scale: £552/£573 p.a. Grade J.13, N.J.B. Conditions.

Applications to Sub-Area Manager, No. 6 Sub-Area, The North Western Electricity Board, Castle Green, Kendal, by 28 Aug., 1954.
(K 709)

BRITISH ELECTRICITY AUTHORITY

Midlands Division

SHIFT CHARGE ENGINEER is required at Hams Hall "B" Power Station. N.J.B. service conditions, superannuable appointment, salary within Schedule "A," Grade K7, £869 to £907 per annum.

Applicants should have received a sound technical training and power station practical experience in the operation and maintenance of steam generating plant, main switchgear, and pulverised fuel firing. Appropriate qualifications an advantage.

Apply, quoting Vacancy No. 740MD, on form AE6, available from the Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, by 28 Aug., 1954.
(K 721)

BRITISH ELECTRICITY AUTHORITY
South-Eastern Division

APPLICATIONS are invited for ENGINEERING DRAUGHTSMEN at Divisional Headquarters, Kingston, who have ambition for progress by merit, and have the necessary educational requirements to be capable after training of carrying out all necessary design calculations on mechanical or electrical plant. Good Technical College facilities. N.J.B. conditions of service. Salary according to ability within range of £458/£595. 7s. p.a. including London allowance. Detailed written applications should be received by the Establishments Officer, British Electricity Authority, Lower Ham Rd, Kingston-on-Thames, by 28 Aug., 1954. (K 732)

THE BRITISH IRON AND STEEL RESEARCH ASSOCIATION

ELECTRICAL ENGINEER required by the Plant Engineering Division of the above Association to carry out applied research in the Iron and Steel Industry. Honours degree in electrical engineering essential. Age range 23-28. Starting salary according to age, qualifications and experience up to £800 p.a. Post is superannuated under the F.S.S.U. Location of Work, London. Written applications only to Personnel Officer, B.I.S.R.A., 11 Park Lane, London, W.1. (K 717)

SOUTH EASTERN ELECTRICITY BOARD
SENIOR SHOWROOM ASSISTANT
Kingston and District

SALARY £485 x £20—£545 under N.J.C. Grade 2, plus London Weighting. Superannuable. The successful applicant will be primarily in charge of the Weybridge Showroom and responsible to the District Commercial Engineer, but may be required to work at any of the district's showrooms. Applicants should have had experience in an electricity supply showroom and be capable of advising consumers on apparatus.

Applications on forms from D. C. Thomson, B.SC., M.I.E.E., Kingston and District Manager, SEEBoard, 22 Claremont Rd, Surbiton, Surrey, to be returned naming two referees by 1 Sept., 1954.

JUNIOR ENGINEER
Medway District

Salary £466 p.a. under N.J.B. Class F, Grade 14. Superannuable. Applicants to hold the Higher National Certificate for Electrical Engineering or equivalent, and had training and experience in Underground and Overhead Distribution. The position will eventually entail standby duties.

Applications naming two referees to Ramsden Mellor, M.I.E.E., District Manager, SEEBoard, Gardiner St, Gillingham, Kent, by 1 Sept., 1954.

A. L. BURNELL,
Secretary.
(K 741)

BRITISH ELECTRICITY AUTHORITY
Midlands Division

THIRD ASSISTANT ENGINEER (Civil) is required in the Transmission Department at Divisional Headquarters. National Joint Board service conditions, superannuable appointment, salary within Schedule C, Grade 5, of the Agreement, £649/£858 per annum.

Applicants should have received a thorough training in civil engineering and preferably have passed parts "A" and "B" of the examination for Associate Membership of the Institution of Civil Engineers, or hold qualifications exempting them therefrom. They should have had experience in the design, setting out and supervision of siteworks, foundations, buildings and reinforced concrete structures, and should be accustomed to dealing with specifications, bills of quantities, drawings and correspondence relating thereto.

Apply, quoting Vacancy No. 738MD, on form AE6, available from the Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, by 28 Aug., 1954. (K 723)

SOUTH WEST SCOTLAND ELECTRICITY BOARD
Lanarkshire Sub-Area
APPOINTMENT OF THIRD ASSISTANT DISTRICT ENGINEER, RUTHERGLEN DISTRICT

APPLICATIONS are invited for the appointment of Third Assistant District Engineer, Rutherglen District.

Candidates should preferably be Graduates of the Institution of Electrical Engineers or hold equivalent qualifications. They should have had a sound engineering training with subsequent experience in the operation and maintenance of H.V. and L.V. Switchgear and Overhead and Underground Distribution Systems.

The Salary and Conditions of Service for this appointment will be in accordance with the National Joint Board's Agreement, Schedule "A." The present classification and grading will be "E"9, salary £587/£600 per annum, which will be subject to the statutory deductions, including superannuation.

Applications forms, which may be obtained from the undersigned, should be returned to this office within 14 days of the date of this notice.

DUGALD SMITH,
137 Almada St, Manager.
Hamilton.
19 Aug., 1954. (K 737)

BRITISH ELECTRICITY AUTHORITY
Midlands Division

GENERAL ASSISTANT ENGINEER is required in the System Operation Department at Divisional Headquarters. National Joint Board service conditions, superannuable appointment, salary within Schedule C, Grade 8, commencing in the range £501 to £639, ultimately rising to £714 per annum.

Duties are of a general statistical and technical nature, associated with the group operation of power stations, and the successful applicant will be required to carry out shift duties as necessary in the System Control Room. Power Station experience and appropriate technical qualifications will be considered advantages.

Apply, quoting Vacancy No. 739MD, on form AE6, available from the Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, by 28 Aug., 1954. (K 722)

ASSISTANT LECTURER
(ELECTRICAL ENGINEERING)

required by NIGERIA EDUCATION DEPARTMENT for two tours of 18 to 24 months or three tours of 10 to 12 months in the first instance. Option of appointment either (*a*) on agreement with prospect of permanency with salary scale (including expatriation pay) £750 rising to £1,315 a year or (*b*) on contract with salary scale (including expatriation pay) £807 rising to £1,453 a year plus gratuity at the rate of £100/£150 a year. Outfit allowance £60. Free passages for the officer and wife. Assistance towards cost of children's passages or grant up to £150 annually for maintenance in U.K. Candidates should possess the H.N.C. in Electrical Engineering or equivalent qualification and have had previous teaching and industrial experience. Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/30630/EE. (K 739)

BRITISH ELECTRICITY AUTHORITY
South Eastern Division

JUNIOR ENGINEER (CONTROL)—Kingston "B" Power Station. Applicants should preferably have had experience in the operation of E.H.T. Switchgear and the parallel running of alternators. N.J.B. Conditions of Service. Class G, Grades 16/14 commencing at £427 p.a. incl. London allowance. Applications giving details of education, present position, experience etc., to be sent to Station Superintendent, Kingston "B" Power Station, Downhall Road, Kingston-on-Thames, by 28 Aug. (K 747)

BRITISH ELECTRICITY AUTHORITY
South Wales Division
Vacancy No. 83/54

APPLICATIONS invited for superannuable N.J.B. appointment of GENERAL ASSISTANT ENGINEER, Technical Department, Divisional Headquarters. Salary AX/CX 8, £501/£675 per annum.

Candidates should possess a degree or H.N.C. in Electrical Engineering; some experience in the manufacture, design or erection of high voltage transmission equipment desirable. Required to assist in the design of a 132 kV transmission system and in the investigation of a wide range of system problems, including fault calculations and load flow studies.

Application forms obtainable from Secretary, South Wales Division, British Electricity Authority, Twyn-y-Fedwen Rd, Gabalfa, Cardiff, by 30 Aug., 1954. (K 719)

DIESEL ELECTRIC SUPERVISOR

required by the NIGERIA RAILWAY for one tour of 18/24 months in the first instance. Appointment either (*a*) on contract terms with salary scale (including expatriation pay) £1,170 rising to £1,453 a year plus gratuity at rate of £150 a year or (*b*) with prospect of permanency with salary scale (including expatriation pay) £1,085 rising to £1,315 a year. Outfit allowance up to £60. Free passages for officer and wife. Assistance towards cost of children's passages or grant up to £150 annually for maintenance in United Kingdom. Liberal leave on full salary. Candidates should have served an apprenticeship with a manufacturer of electric traction equipment or with an electric traction department of a Railway and have had at least seven years' subsequent workshop experience in the overhaul and operation of traction equipment. Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/30564/EE. (K 740)

CITY OF LIVERPOOL
City Engineer and Surveyor's Department

APPLICATIONS are invited for the appointment of
ELECTRICAL ENGINEER. Salary, £580 x £15 x £20—£670 per annum (£580 x £15 x £20—£670 per annum (APT. GRADES IV/V).
National Certificate in Electrical Engineering, or other appropriate qualification, be capable of preparing specifications, schemes and estimates for complete lighting and power installations, and modification and improvement of installations in Schools and supervising the work under construction.

Application forms, obtainable from the City Engineer and Surveyor, Municipal Buildings, Liverpool 2, should be returned to him by 10 Sept., 1954.

The appointment is superannuable and subject to the Standing Orders of the City Council. Canvassing disqualifies.

THOMAS ALKER,
Municipal Buildings, Town Clerk.
Liverpool 2 (JA. 3653). (K 746)

THE NORTH EASTERN ELECTRICITY BOARD
Harrogate Sub-Area

APPLICATIONS are invited for the appointment of GENERAL ASSISTANT ENGINEER, Harrogate. Duties will be in connection with new construction work and include survey for overhead lines, cables and substations and the preparation of technical details. Previous experience in this work desirable but not essential. Salary, Schedule "A," Class "G," Grade 12, £534/£555. N.J.B. conditions of service.

Applications, stating age, qualifications and experience should be forwarded to the Secretary (Establishments), The North Eastern Electricity Board, P.O. Box 117, Carliol House, Newcastle upon Tyne, within ten days of the appearance of this advertisement. (K 738)

EASTERN ELECTRICITY BOARD

Headquarters

APPLICATIONS are invited for the following vacancies:

110/54.N

(*a*) SALES LECTURER
(*b*) INSTRUCTOR—LECTURER

These appointments are on the Headquarters staff but the successful candidates will be located at the Board's Sales Training School at Hatfield, Herts.

Candidates for post (*a*) will be required to give instruction on the Board's sales policy and tariffs and should have had wide sales experience gained in a responsible position with a progressive sales organisation. A knowledge of sales technique, service centre display, window dressing, demonstrating, deportment and personnel relations is essential.

The salary will be in accordance with Grade 8 (£895 x £35—£1,000) for a "Principal Assistant" under the National Joint Council Salary Agreement.

For post (*b*) candidates should have a knowledge of modern installation practice, domestic electrical appliances, space heating, refrigeration and domestic, commercial and industrial utilisation. Corporate membership of the Institution of Electrical Engineers will be an advantage.

The commencing salary will be £790 in accordance with Grade 5, Class AX/DX (£790/£858) for a 3rd Assistant Engineer under the National Joint Board Salary Agreement.

Apply to the Chief Commercial Officer, Eastern Electricity Board, Wherstead, Ipswich, Suffolk.

Chilterns Sub-Area

Luton District

85/54.R

FIRST ASSISTANT DISTRICT ENGINEER

Candidates should have had a sound technical training and wide experience of the planning, construction, operation and maintenance of H.V. and L.V. underground and overhead systems, including substations. Corporate membership of the Institution of Electrical Engineers would be an advantage.

Salary in accordance with Class G, Grade 5, of the National Joint Board Salary Agreement commencing at £831.

Apply to the District Manager—Luton, Eastern Electricity Board, 487 Dunstable Rd, Luton, Beds.

Fens Sub-Area

Peterborough

111/54.R

SERVICE CENTRE ASSISTANT
(MALE OR FEMALE)

Candidates should preferably have experience of electrical appliances and an aptitude for selling. Possession of the E.D.A. Diploma would be an advantage.

Salary in accordance with the General Clerical Grade of the National Joint Council Salary Agreement on the scale for males £170/£470 and for females £138/£380, the commencing point depending on age and ability.

Apply to the Secretarial Officer, Fens Sub-Area, Eastern Electricity Board, Milton Hall, Milton, Cambridge.

Norfolk Sub-Area

Norwich District

117/54.N

DEMONSTRATOR

Candidates should have had Domestic Science training including Electrical Housecraft, should preferably hold the E.A.W. Certificate and be competent to plan and give cookery demonstrations, including lectures and advice to consumers on the utilisation of domestic electrical apparatus. Previous experience in an Electricity Service Centre is desirable.

Salary in accordance with Grade 1 (£400 x £20—£480 x £10—£490) of the National Joint Council Salary Agreement although progress beyond £400 will be subject to a certificate that the person concerned is capable of undertaking all the duties of the grade.

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Apply to the District Manager—Norwich, Eastern Electricity Board, Duke St, Norwich, Norfolk.

Northmet Sub-Area Headquarters

115/54.R

SENIOR DRAUGHTSMAN AND ENGINEERING DRAUGHTSMAN

The duties include layout of switchgear, transformers and associated equipment for outdoor and indoor type substations up to 33 kV.

Salary in accordance with the National Joint Board Salary Agreement as follows:

Senior Draughtsman—Schedule D, Grade 5, £567/£671 plus London Allowance.

Engineering Draughtsman—Schedule D, Grade 6, £433/£567 plus London Allowance.

Apply to the Manager, Northmet Sub-Area, Eastern Electricity Board, Northmet House, Southgate, London, N.14.

GENERAL ASSISTANT ENGINEERS

Required in the following localities:

112/54.R

(1) North Essex District, Essex Sub-Area.

113/54.R

(2) Letchworth, Stevenage District, Northmet Sub-Area.

114/54.R

(3) Two—St. Albans and Welwyn Garden City District, Northmet Sub-Area.

Candidates should have had a sound training in electrical engineering and experience in the construction, operation and maintenance of overhead and underground distribution systems, including substations.

Salary in accordance with the National Joint Board Salary Agreement as follows:

(1) Class E, Grade 11, commencing at £524.
(2) Class E, Grade 11, commencing at £524.
(3) Class F, Grade 11, commencing at £548.

Apply as follows:

(1) The District Manager, Eastern Electricity Board, Cressing Rd, Braintree, Essex.

(2) The District Manager, Eastern Electricity Board, 38 High St, Stevenage, Herts.

(3) The District Manager, Eastern Electricity Board, 107 St. Peter's St, St. Albans, Herts.

JUNIOR ENGINEERS

Required in the following localities:

118/54.R

(1) Bishop's Stortford District, Northmet Sub-Area.

119/54.R

(2) King's Lynn and Western District, Norfolk Sub-Area.

120/54.R

(3) Fens Sub-Area Headquarters, Cambridge.

Candidates should have had a good general and technical education and possess the Higher National Certificate or an equivalent qualification.

Salary in accordance with the National Joint Board Salary Agreement as follows:

(1) Class D, Grade 14, at £473.
(2) Class E, Grade 14, at £445.
(3) Class H, Grades 17-14 within a range of £402/£516 commencing at a point dependent upon qualifications and experience.

Apply as follows:

(1) The District Manager, Eastern Electricity Board, 25 North St, Bishop's Stortford, Herts.

(2) The District Manager, Eastern Electricity Board, Gaywood Bridge, Wootton Rd, King's Lynn, Norfolk.

(3) The Manager, Fens Sub-Area, Eastern Electricity Board, Milton Hall, Milton, Cambridge.

Future salary and conditions of service for all these appointments will be in accordance with agreements made from time to time by the appropriate negotiating bodies.

The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Applications by letter, stating age, education, qualifications and experience with details of present appointment and salary, should be submitted to the Manager concerned within fourteen days of the appearance of this advertisement. (K 744)

COUNTY OF LEICESTER

ASSISTANT ELECTRICAL ENGINEER £550/£595. Should have sound knowledge electrical installation work and experienced in preparing reports, specifications and estimates.

Must have Higher National Certificate in Electrical Engineering or Section A Certificate of the Institution of Electrical Engineers. Apply by 6 Sept. on form obtainable from County Architect, 123 London Rd, Leicester. (K 748)

THE SOUTH WALES ELECTRICITY BOARD

REQUIRED SURVEYOR DRAUGHTSMAN in the West Central Sub-Area at Fforestfach.

Salary—Schedule D (£433/£567) of N.J.B. Agreement.

Applications stating age, present position and salary, qualifications, experience and three referees, to be addressed to the Secretary to arrive by 28 Aug., 1954.

D. G. DODDS,
Secretary.

St. Mellons,
Cardiff. (K 743)

RADIO TECHNICIAN

required as SIGNALS ASSISTANT INSPECTOR OF POLICE by NYASALAND GOVERNMENT for one tour of 2-3 years with prospect of permanency. Salary scale (including present temporary allowance of approx. 13% of salary) £651 rising to £1,103 a year. Commencing salary according to experience. Outfit allowance £50. Uniform allowance £10 a year. Free passages. Liberal leave on full salary. Candidates must be between 21 and 30 years of age, of good education and physique, not below 5 ft 7 in. in height, normal vision without glasses. They must have a sound knowledge of H.F. and V.H.F. fixed and mobile simplex and duplex radio telephone systems and low power petrol/electric charges and alternators. Knowledge of morse and ability to instruct trainees in radio subjects desirable. Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M1/36023/EE. (K 725)

LONDON ELECTRICITY BOARD

ENGINEERING DRAUGHTSMEN

APPLICATIONS are invited for positions as Engineering Draughtsmen for electrical plant layout in the Drawing Office of the Chief Engineer's Department in central London.

Applicants should preferably have served an engineering apprenticeship and have had technical training. Experience in the layout of transforming plant, H.V. switchgear and cables would be an advantage.

The posts are graded under Schedule "D" of the N.J.B. Agreement as Grade 6 (£458/£595. 7s. per annum, inclusive of London Allowance) and the commencing salaries will be dependent upon qualifications and experience.

Application forms obtainable from Personnel Officer, 46 New Broad St, E.C.2, to be returned completed not later than 31 Aug., 1954. Please enclose addressed envelope and quote ref.: V/1736/T. on envelope and all correspondence. (K 698)

THE JERSEY ELECTRICITY CO. LTD.

SHOWROOM SUPERVISOR at the Company's main Showroom, St. Helier. Energetic man wanted immediately, with good knowledge of domestic and commercial equipment and supply industry matters. Able to control and direct sales staff and deal with manufacturers, ordering and stocktaking. Display experience an advantage. Plenty of scope for the man who is not afraid of responsibility.

Commencing salary: £650 p.a. plus bonus (Jersey Income Tax is 2s. to 4s.).

There are also vacancies for SHOWROOM ASSISTANTS who have the ability and enthusiasm for selling. Commencing salary: £8 10s. per week, plus bonus.

Applications to be sent to the Managing Director, at 11 Broad St, Jersey, C.I. (K 764)

MIDLANDS ELECTRICITY BOARD

GENERAL ASSISTANT ENGINEERS required in the Commercial Department of the Central Gloucestershire Sub-Area.

Previous experience in commercial or distribution activities an advantage. Technical qualifications desirable. Salary £523/£542 per annum (N.J.B. H13) or £565/£586 per annum, (N.J.B. H12) according to experience. Superannuable.

Apply in writing within fourteen days to:—Mr D. Holt, Sub-Area Manager, Central Gloucestershire, Midlands Electricity Board, 126 London Rd, Gloucester.

A. STEPHENS,
(Secretary).
(K 745)

ALKALINE BATTERIES LTD., of Redditch, are the largest makers in the Empire of Alkaline accumulators, miners' lamps and emergency lighting systems, which are in rapidly growing use particularly for export. The company has vacancies in its Technical Sales and Development Sections for Graduate ELECTRICAL ENGINEERS, not over 30 years of age, or for men nearing the end of their Degree Course who have completed National Service. The posts are pensionable and offer the prospect of executive rank. Applications with full educational details and experience should be addressed to Commercial Manager, Alkaline Batteries Ltd., Union St, Redditch.
(K 23)

A MEDIUM-sized firm of Cable Makers require a METHODS ENGINEER who is prepared to adapt existing plant and change methods where necessary. Technical knowledge is desirable but not essential. Apply—Box No. 3751, Electrical Times.
(K 714)

APPLICATIONS are invited by a prominent electrical manufacturing organisation from YOUNG MEN in the age group 25/30 years, who are interested in the sales of F.H.P. motors. Vacancies exist in London and the Provinces for those who are seeking a position offering excellent opportunities of advancement and who possess initiative and drive. Apply in writing, supplying full details of training and experience to—The Staff Manager, Box No. 3759, Electrical Times. (K 754)

ASSISTANT MANAGER required by progressive, well established, electrical contractors, Norfolk. Experience of Air Ministry internal wiring an advantage. Good prospects for capable hard-working executive with ultimate possibility of Directorship. Must be able to handle work from estimate to final bill. Experience, age, in confidence, to Chairman—Box No. 3747, Electrical Times.
(K 712)

A WORKS SUPERINTENDENT required by Rubber and Plastic Cable Makers, well versed in modern production techniques. Apply—Box No. 3753, Electrical Times.
(K 715)

BRITISH ELECTRICITY AUTHORITY Commercial Department Headquarters, require GENERAL ASSISTANT AND JUNIOR ENGINEERS. The duties, which provide scope for enterprise and initiative, are concerned with tariffs and the commercial development of the Electricity Supply Industry and extend from generation to utilisation. Candidates should be capable of undertaking studies of wide general interest to the Industry, and preference will be given to those who have some practical experience in Electricity Supply and in Economic Investigation. An Engineering Degree or Higher National Certificate in Engineering would be an advantage. Salaries, including London Allowance: General Assistant Engineers, N.J.B. Grade 5, £558/£769 p.a. Junior Engineers £415/£636. Applications stating age, present position and salary, and giving full details of qualifications and experience to D. Moffat, Director of Establishments, British Electricity Authority, Winsley St, London, W.1, by 4 Sept., 1954. Quote Ref. ET*/506.
(K 736)

BRITISH ELECTRICITY AUTHORITY Combustion and Fuel Technology Sub-Branch, London, require a SCIENTIST with a University Degree and Corporate Membership of the R.I.C. or the I.C.E. to work on boiler combustion problems as junior assistant to the Scientific Adviser. Experience of power station practice will be an advantage, but is not essential. The successful candidate will acquire experience of power station boiler practice, particularly with relation to the coals burned, and also the microscopy of external boiler deposits. Salary N.J.B. Grade 5, £558/£698, according to qualifications and experience, rising to £769 inclusive.

Applications stating age, qualifications, experience, present position and salary to D. Moffat, Director of Establishments, Winsley St, London, W.1, by 6 Sept., 1954. Quote Ref. ET*/507. (K 718)

CASHIER / BOOK-KEEPER required thoroughly experienced in all aspects of mechanised accounts department of London wholesalers. Excellent opportunity for right person male or female. Write stating age, experience, salary required to—Box No. 3763, Electrical Times. (K 756)

CROMPTON PARKINSON LIMITED invite applications from graduate PHYSICISTS or ELECTRICAL ENGINEERS with good Honours Degrees to work in their Lamp Works Development Laboratory on general lamp problems. Applicants with or without experience will be considered. Good prospects to a man wishing to make a career in industry. Superannuation Scheme to which Company contributes. Send full particulars of education and any practical experience, to Ref. LLD, Crompton Parkinson Limited, Guiseley, Nr. Leeds. (K 727)

DESIGNER required to take full responsibility for the design of all new boxes, cubicles and other fabricated steel assemblies required by the companies in the Metal Industries Electrical Division, namely Brookhirst Switchgear Ltd., Chester; Igranic Electric Co., Ltd.; Bedford and Cantie Switches Ltd., Bromborough, Cheshire.

This is a senior appointment, tenable at the Chester Works, carrying a good starting salary. Applicants must have had considerable experience in the design and manufacture of all forms of steel fabrication. Apply, stating age, qualifications and salary required to Technical Director, Brookhirst Switchgear Ltd., Northgate Works, Chester.
(K 708)

DESIGNER - DRAUGHTSMAN required with good knowledge of the design of H.V. Outdoor Airbreak Switchgear and/or 11 kV Oil-Immersed Metalclad Switchgear. Good opportunity for man with experience and able to work on his own initiative. Help given, if necessary, to obtain living accommodation. Apply in writing, giving full details of qualifications, experience and salary required, to Switchgear and Equipment Ltd., Banbury, Oxon. (K 711)

DESIGN ENGINEER with initiative and experience required for company developing A.C. Air-Break Switchgear. Position offers scope for advancement. Substantial salary will be paid to applicant with suitable qualifications.—Box No. 3739, Electrical Times. (K 701)

DRAUGHTSMEN required by South Wales Switchgear Ltd, at their Blackwood Works for High Voltage Switchgear Contract Works and Diagram Sections. Applications giving full particulars of experience, qualifications and salary required to the Personnel Manager. (K 749)

ELECTRICAL DRAUGHTSMAN required in London for the design and layout of power and lighting installations and distribution systems, including preparation of estimates, etc.; H.N.C. qualification.

Write stating age, qualification, experience and present salary to Box No. 7906, c/o Charles Barker and Sons Ltd., 31 Budge Row, London, E.C.4. (K 707)

ELECTRICAL ENGINEER required for Consulting Engineers, London or Manchester, for inspection at Manufacturers' Works of electrical equipment for power systems. Higher National Certificate Electrical Engineering or equivalent essential. Write stating full particulars of education, experience and salary required.—Box No. 3765, Electrical Times. (K 757)

ELECTRICAL ENGINEER, not over 38, with sound scientific and engineering qualifications and commercial experience, required for Yorkshire factory manufacturing specialised electrical products. Salary based on qualifications and experience. The post offers good prospects for the right person, who must be available to commence on 1 Nov, 1954. Applicants should write, giving full details of age, education, training and experience to—Box No. 3767, Electrical Times. (K 758)

ELECTRICAL ENGINEER required by small firm in N.E. England to supervise the testing and control the quality of low tension control gear. Must also be able to calibrate and check electrical indicating instruments and to design and specify the grading of field rheostats for special purposes. Will be responsible for checking and correcting wiring diagrams, schematics, installation and maintenance instructions. Applications stating age, qualifications, experience and salary required to—Box No. 3733, Electrical Times. (K 684)

FULL TIME REPRESENTATIVE required by leading manufacturers in switch and thermostat field for Northern Counties Area. Contact with Electricity Boards and leading industrial organisations necessary. Reply with full details of experience and remuneration expected to—Box No. 3769, Electrical Times. (K 759)

GRADUATE ELECTRICAL ENGINEER required in the Engineering Organisation of British Insulated Callender's Cables Ltd, at 38 Wood Lane, London, W.12. for development work on high voltage cables and accessories in the voltage range of 33 kV and upwards. Previous experience of cable work is not essential although it would be helpful. Pension Fund. 5 day week. Apply in writing, stating age, qualifications and experience and quoting reference number L.43/54 to Staff Officer, British Insulated Callender's Cables Limited, 21 Bloomsbury St, London, W.C.1. (K 753)

HACKBRIDGE AND HEWITTIC ELECTRIC CO., LTD., Walton-on-Thames, Surrey, require experienced ENGINEERS for their Transformer and/or Rectifier Estimating Departments. Applications to be made in writing giving full details. (K 765)

JOHNSON AND PHILLIPS LIMITED have vacancies in their CABLE ESTIMATING DEPARTMENT for young men, good mathematical standard essential. Preference will be given to men having experience in estimating costs of insulated electric cables and flexible cords.

Applications in writing giving age, experience and salary expected to Employment and Welfare Manager, Messrs Johnson and Phillips Limited, Victoria Way, Charlton, S.E.7. (K 695)

JUNIOR ELECTRICAL DRAUGHTSMAN with some design experience, required by expanding company with H.Q. in London area. Write—Box No. 3755, Electrical Times. (K 720)

JUNIOR ENGINEER (21-25) required in Estimating Department by Electrical Contractors (Westminster), Good Prospects. Write stating experience, age, salary required. —Box No. 3727, Electrical Times. (K 656)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2.

MECHANICAL ENGINEER with good technical qualifications required for 80 MW industrial power station. Age not less than 30. Commencing salary £950 to £1,100, with generous non-contributory pension scheme. Up-to-date and responsible power station experience essential. Apply in writing to Salaried Personnel Department, Ford Motor Company Limited, Dagenham, Essex, quoting reference PHE. (K 610)

ONE ELECTRICAL ENGINEER—25/30 years of age, required by British Acheson Electrodes Ltd of Sheffield, as assistant to Chief Engineer. Applicants should be of B.Sc. Standard but those holding H.N.C. will be considered. Application with full details of age, qualifications and experience should be forwarded to the Personnel Manager. (K 752)

OPPORTUNITY FOR DRAUGHTSMEN. The continued expansion of this Company has created openings for a few draughtsmen to join us.

We offer good prospects in congenial surroundings for:—Electrical Draughtsmen with experience in design of circuits and equipment. Also Draughtsmen for our Layout and Engineering Departments. Apply in writing to Personnel Manager, The Express Lift Co., Ltd. (controlled by the General Electric Co., Ltd.) Abbey Works, Northampton. (K 761)

REPRESENTATIVES for first-class electrical domestic equipment. Must be car owners. Essentially wanting to work hard to launch new products. Bedfordshire, Hertfordshire, Buckinghamshire and Huntingdonshire. Write full particulars to: Napper, Stinton, Woolley Ltd. (BPD) 14-19 Gt. Chapel St, London, W.1. (K 655)

REPRESENTATIVE required by well established manufacturers of high grade switches to cover Northern Counties. Contact with Area Boards and leading industrial organisations an advantage and one or two other agencies in electrical line not objected to. Reply giving full details including experience and remuneration expected to—Box 3735, Electrical Times. (K 685)

REPRESENTATIVE required by well-known Domestic Appliance Manufacturers to cover the Midlands and North including Manchester, Leeds, etc. Wide experience of the Wholesale Trade, Electricity Boards and Local Authorities essential. Remuneration by Salary, Commission and Expenses. Must be car owner. Position offers vast scope to successful applicant. Present Staff notified.—Box No. 3749, Electrical Times. (K 713)

STEAM TURBINE ENGINEERS—The General Electric Co., Ltd., invite applications to their Fraser and Chalmers Engineering Works, Erith, Kent, for positions in their Sales and Contracts Departments. Progressive opportunities exist, with salary appropriate to qualifications and experience for Engineers aged 28 to 40, with the following as a minimum:

1. H.N.C. Mech. Eng., preferably supported by electrical training.
2. Apprenticeship, or post apprenticeship practical work for two years, on Steam Turbine plant.
3. Position for two years in Office handling tenders and correspondence regarding Power Plant or similar experience.

Apply Personnel Manager, Fraser and Chalmers Engineering Works, Erith, Kent. (K 766)

TECHNICAL ENGINEER (ELECTRICAL) required by Glasgow firm of Manufacturing Engineers to assist in design and development work on an important new project. Applicants should be honours graduates in electrical engineering with a few years post graduate industrial experience. Written applications are desired in the first instance outlining technical education, qualifications and experience and approximate starting salary required. A superannuation scheme is operated. Write 1387, Wm. Porteous and Co., Glasgow. (K 751)

SIMPLEX ELECTRIC CO., LTD.

Water Heating Department

APPOINTMENT OF SALES MANAGER

Applications are invited for the position of Sales Manager, Water Heating Department which is located at the Blythe Bridge Factory, near Stoke-on-Trent. Applicants who should be between the ages of 30 and 45 must have had considerable experience in the electric water heating field, preferably in an executive capacity. Applications in writing, giving full details of experience, qualifications and salary required, should be addressed to the Secretary, Simplex Electric Co., Ltd., Oldbury, Birmingham. (K 760p)

TANGANYIKA. TECHNICAL ASSISTANT to General Manager Dar-es-Salaam and District Electric Supply Co., Ltd., with knowledge and practical experience of diesel and hydro-electric generating stations ranging from 200 kW to 10,000 kW. Applicant to be a Graduate or A.M.I.E.E. or M.E. Age about 30. Salary about £950 p.a. including allowances with free housing (with heavy furniture) and electricity; medical scheme and Pension Scheme. 3-year tour with 6 months' paid leave and paid passages for employee and wife with allowances for children. Write Box E.T.177, c/o 191 Gresham House, E.C.2. (K 692)

TECHNICAL CLERK required for estimating quantities and ordering conduit and wiring with practical experience of installation and ability to read wiring diagrams. Write age, qualifications and salary required, to Personnel Manager, Waygood-Otis Ltd., Falmouth Rd, S.E.1. (K 700)

TECHNICAL ASSISTANT to Development Engineer required by specialist electrical equipment manufacturers on South Coast. Established over 60 years. Permanent. Interesting prospects for young man with initiative. Design and Drawing Office experience essential. Completed apprenticeship with at least H.N.C. an advantage. Applications with full details to—Box No. 3741, Electrical Times. (K 702)

TESTERS are required for the Production Test Department at Messrs Igranic Electric Co., Ltd., a progressive company within the Metal Industries Group. Applicants should be skilled in the interpretation of key and final wiring diagrams and have had control gear experience. There will be an opportunity for promotion to the sales and technical engineering departments at a later date. Successful applicants can expect initially up to £12. 10s. per week; weekly staff; 44 hours; pension scheme.

Please forward your application to the Group Training and Personnel Officer, Metal Industries Ltd., Universal House, 60 Buckingham Palace Rd, London, S.W.1. (K 733)

THE GENERAL ELECTRIC CO., LTD., invites applications from those who are interested in joining the Head Office of their SALES ORGANISATION in London. Applicants should not be more than 30 years of age and possess the Ordinary National Certificate in Electrical Engineering. Excellent opportunities for progress are available to those having good personal qualities, and a keen interest in the selling of electrical products. Apply in writing giving full personal details and record of previous experience to The Staff Manager, Magnet House, Kingsway, W.C.2. (K 750)

TRAINING OFFICER, South Lancashire area, to co-ordinate Technical Studies with Practical Training in Workshops and Offices for Technological and Technician Apprentices. Good salary for Graduate or otherwise Qualified Engineer with previous Industrial and/or Service Training experience. Applications to be made in writing stating age, qualifications and full details, marking envelopes "Training Officer," to—Box No. 3717, Electrical Times. (K 633)

TWO CHEMISTS required in the laboratories of Electric Cable Manufacturers in the Manchester area, for work controlling raw materials, processes and finished products. Age about 25 years. Graduate or A.R.I.C. standard preferred. H.N.C. lowest acceptable standard. Salary according to age, qualifications and experience. Apply giving full details to—Box No. 3757, Electrical Times. (K 729)

APPOINTMENTS WANTED

PRACTICAL ELECTRICAL MAINTENANCE FOREMAN, 15 years' electrical erection and installation, 15 years' steel maintenance, requires change.—Box No. 3743, Electrical Times. (K 703)

QUALIFIED EXPERIENCED ENGINEER, A.M.I.E.E. (LON.)., etc., Branch Manager of an engineering firm in India, handling English and American electrical equipments, instruments and machinery, ex-Naval officer, good organiser, Indian (Parsee), desires change. Invite offers as manufacturer's representative or senior executive in India or abroad.—Box No. 3731, Electrical Times. (K 659)

TO Radio and Electrical Manufacturers. SALES ENGINEER, live connection, Wholesalers. Excellent references and sound background, wishes Agency and Representation.—Box No. 3771, Electrical Times. (K 763)

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WANTED, D.C. and A.C. ball-bearing MOTORS, motor generator sets, dynamos and alternators.—Full details to Britannia Manufacturing Co., Ltd., 22-26 Britannia Walk, London. N.1. (K 3)

WANTED Regularly Used Mercury AIRCRAFT SPARKING PLUGS, Contacts, precious, high grade, and non-ferrous scrap metals, wastes, etc. Keenest prices. Belgrave Buyers (E.T.), 5 Belgrave Gar, London, N.W.8. MAI 7513. (K 687)

WANTED. ROTARY CONVERTERS, any size.—Universal, 221 City Rd, London, E.C.1. (K 4)

WANTED, for prompt cash, ferrous and non-ferrous SCRAP; also plant for dismantling. Buyers of secondhand machinery and plant for re-use.—W. and H. Cooper Ltd., 176 Brady St, Bethnal Green, E.1. (K 1)

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HOLDING Company wishes to acquire controlling interest in established concerns making equipment used by the distribution side of the Electrical Industry. Management need not change. Enquiries, treated in strictest confidence, to—Box No. 3729, Electrical Times. (K 657)

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ELECTRICAL CONTRACTING and and Retail Business in West Midlands for sale including freehold property comprising shop, office, living accommodation, stores and garage. Established over thirty years. Turnover £8,000 to £10,000. Including Plant and machinery. Splendid opportunity and scope for expansion. Owner retiring. Price £3,500, stock at valuation. Apply—Box No. 3761, Electrical Times. (K 755)

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A.A. ELECTRICAL CO. for A.C.-D.C. MOTORS, switchgear, exhaust fans, hoists, reduction gears, new or reconditioned units.—Chi. 5105, 67 Rothschild Rd, W.4. (K 5)

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A.C. and D.C. MOTORS, all sizes, large stocks. Fully guaranteed.—Milo Engineering Works Ltd., Milo Rd, East Dulwich, S.E.22 (Forest Hill 2278-9). (K 2)

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EVERSHED VIGNOLES, No. 67008, 500 V, Bridge Type, MEGGER RESISTANCE TESTER. Perfect order. Cost £74. Accept £30. Also Megger Tester No. 54009 in leather case, perfect order, cost £56, accept £20 or near offers. Osborn, 41 Westminster Bridge Rd. Waterloo 4242. (K 730)

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FRACTIONAL H.P. MOTORS, ¼, ⅓, 1,450 r.p.m., a.c., 230 V, capacitor type, several makes, used, but tested, £3. 15s. including carriage.—Box No. 3745, Electrical Times. (K 705)

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MISCELLANEOUS

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FREE! Brochure giving details of courses in Electrical Engineering and Electronics covering A.M.Bri.I.R.E., City and Guilds, etc. Train with the postal Training College operated by an Industrial Organisation. Moderate fees. E.M.I. Institutes, Postal Division, Dept. ET29, E.M.I. Institutes, London, W.4. (K 17)

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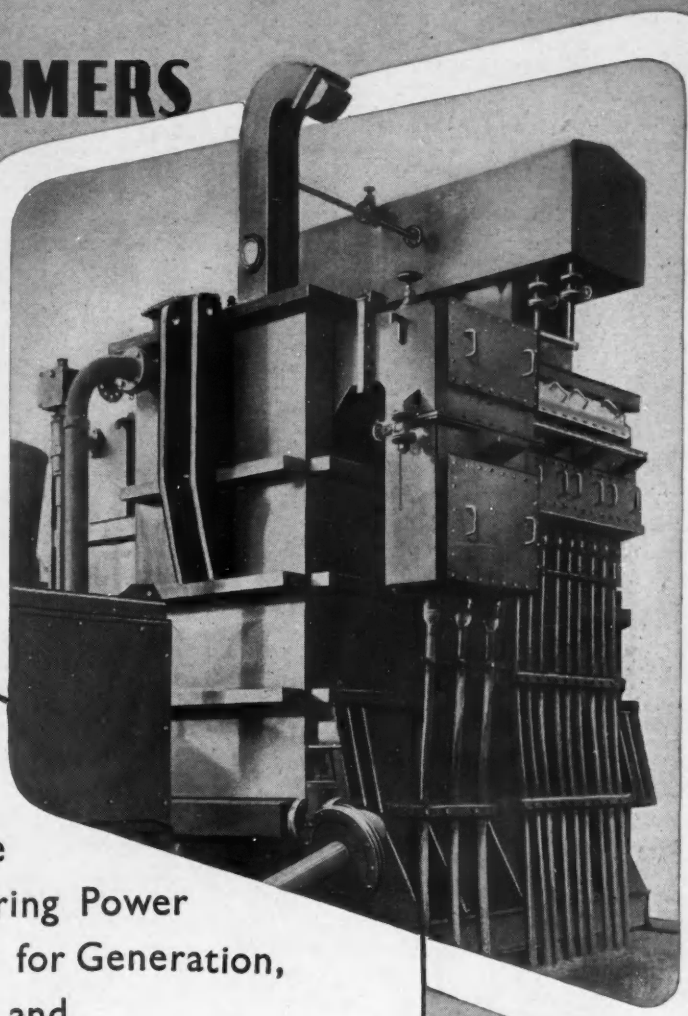

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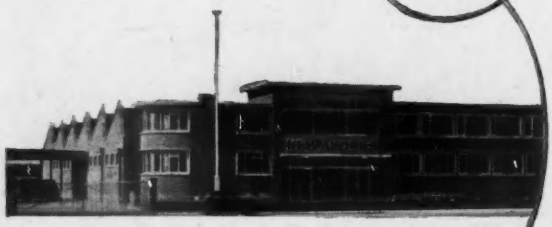

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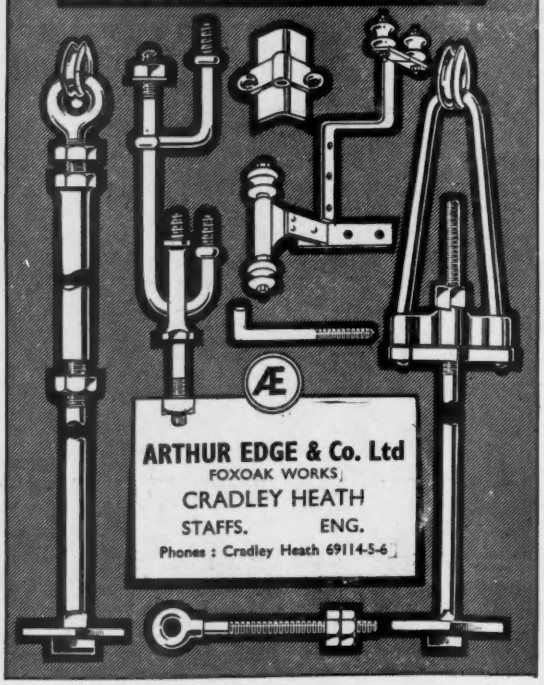

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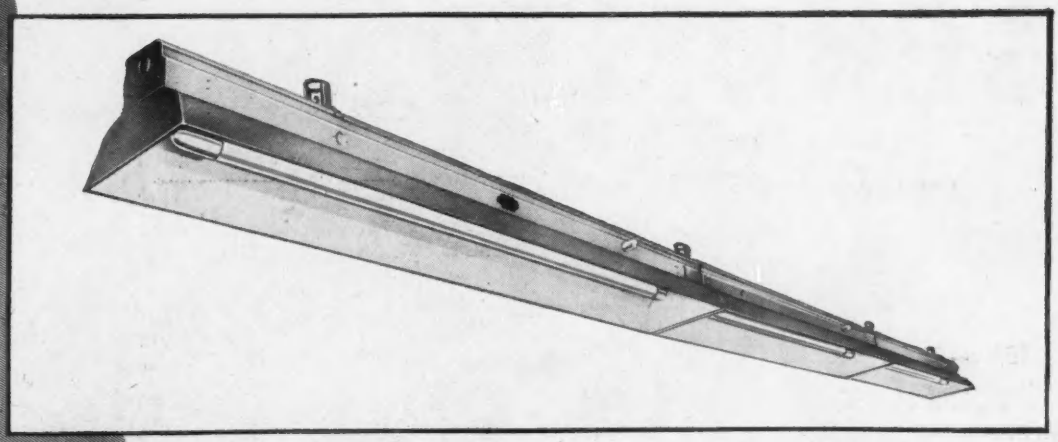

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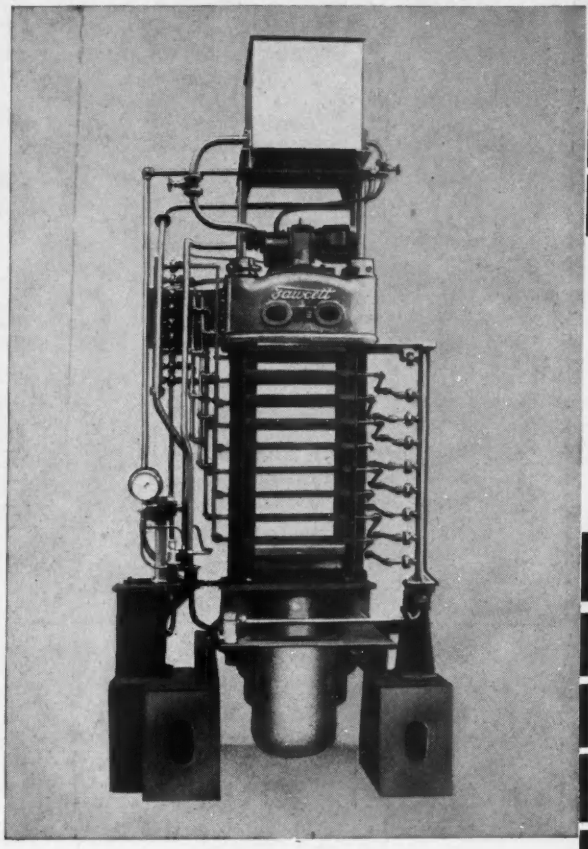

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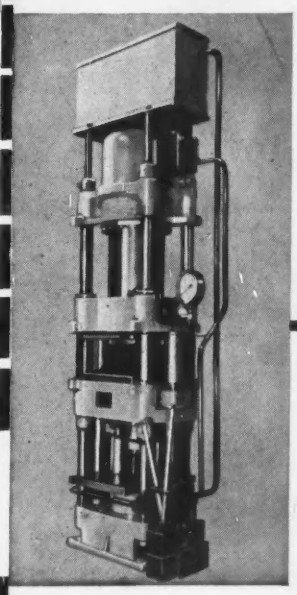

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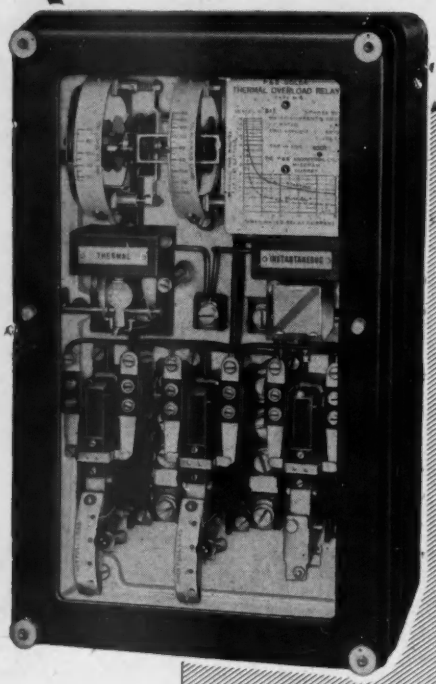

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60	T1S60	616	903	2022
100	TC100	615	932	2021
200	TF200	251	933	2033
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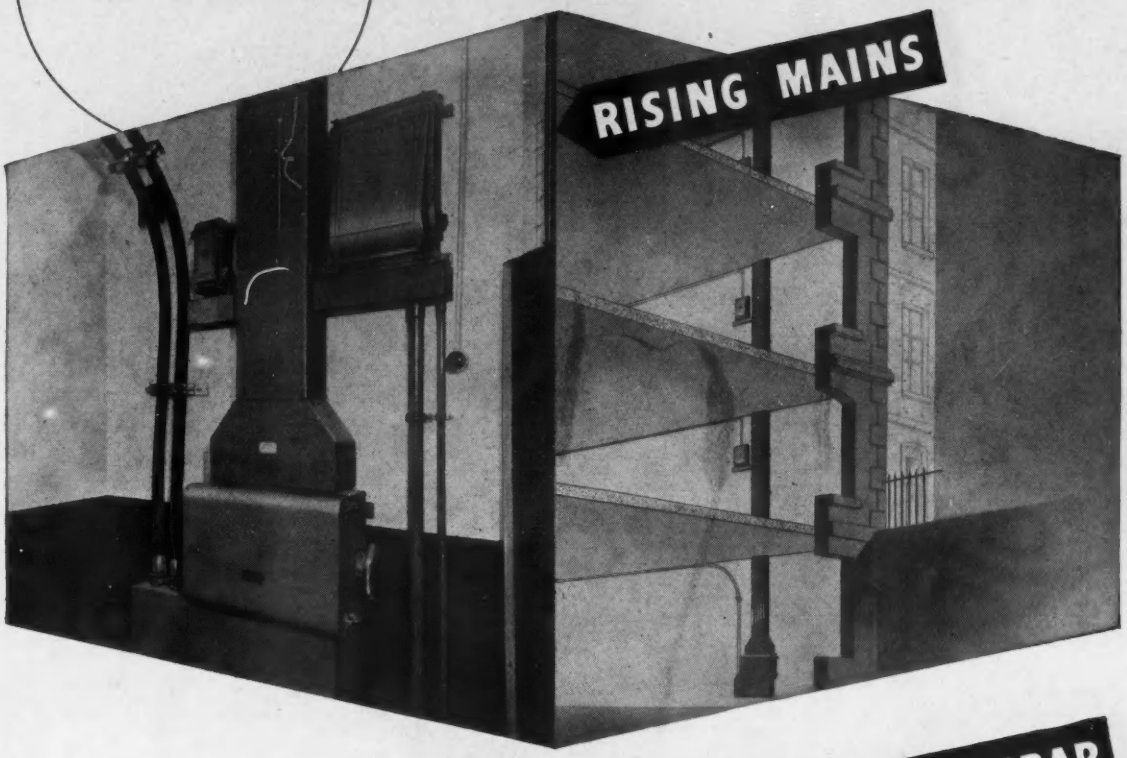

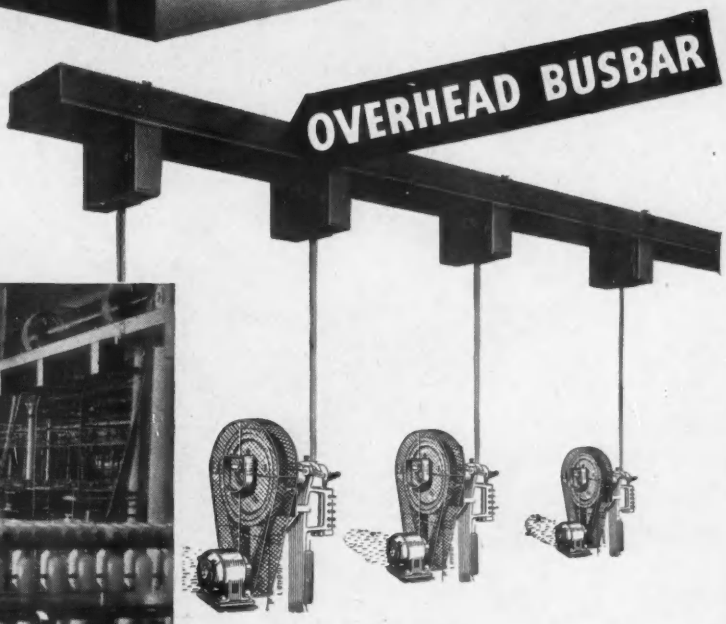

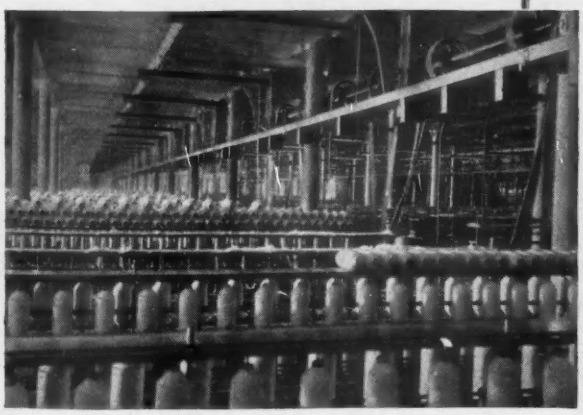

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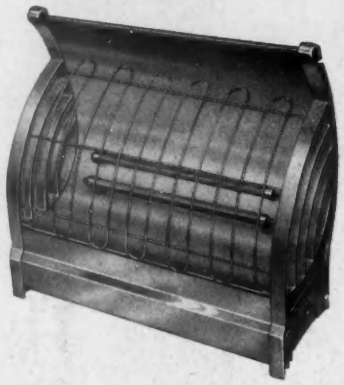

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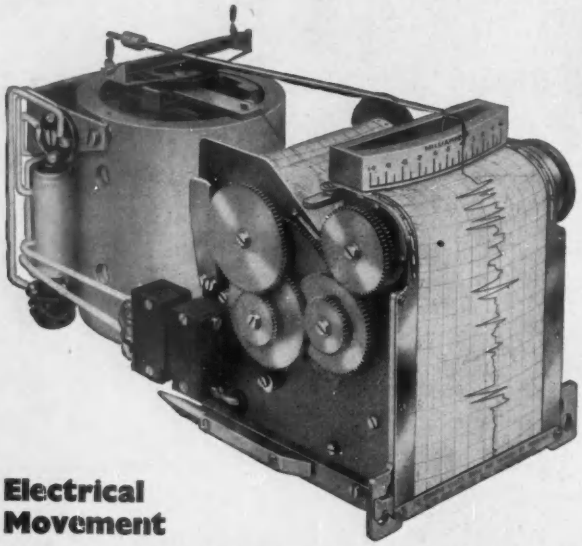

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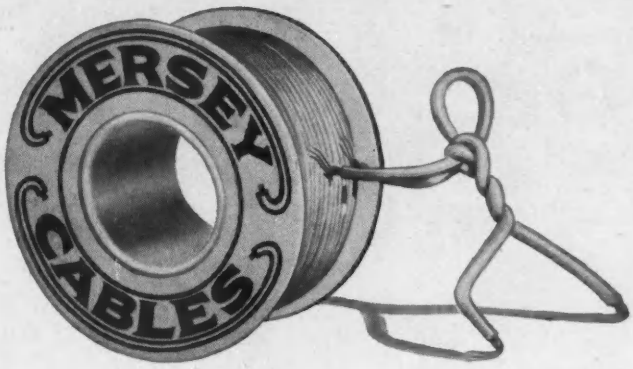

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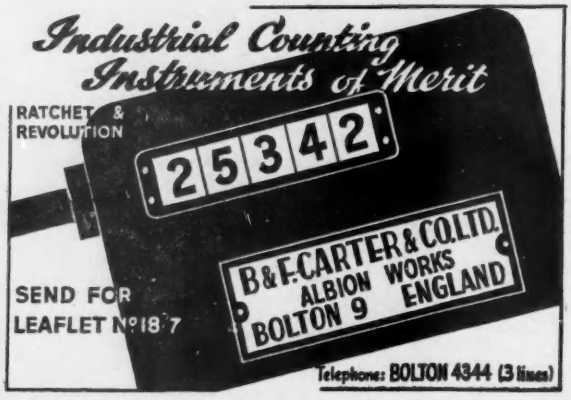

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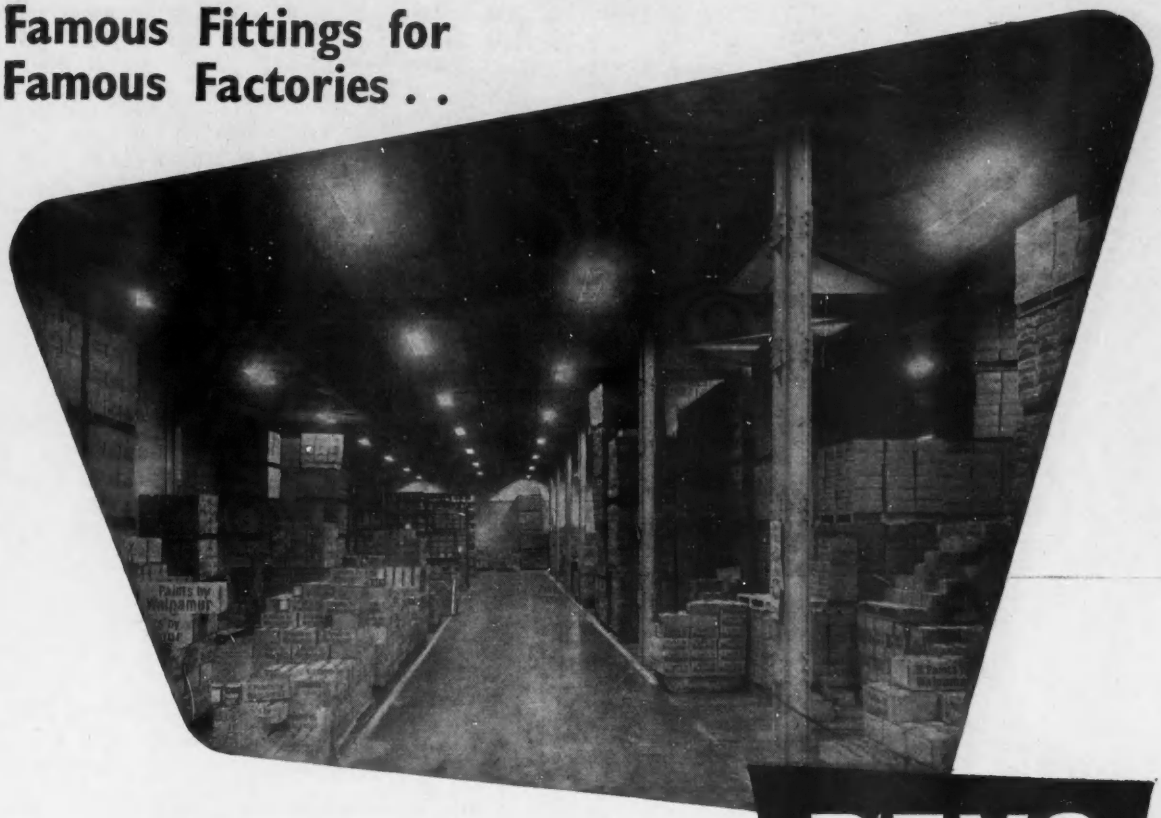

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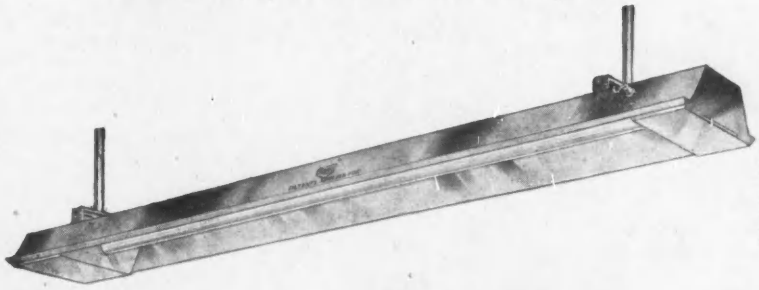

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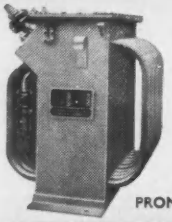

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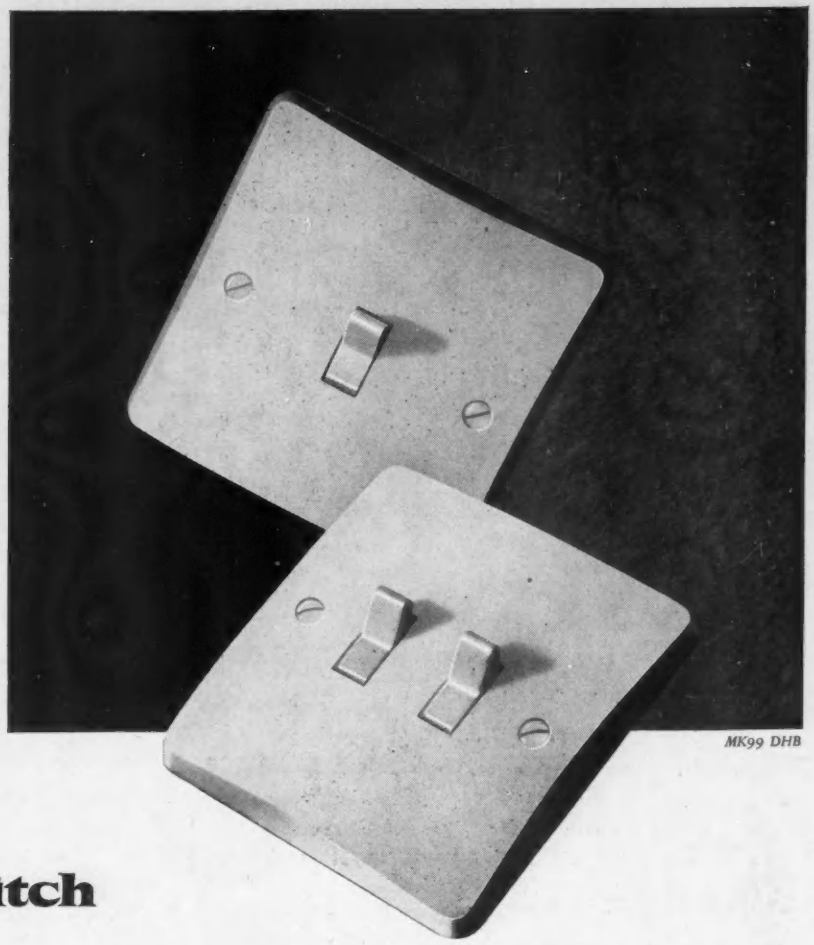

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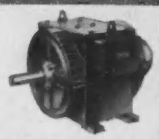
the	BRUSH		Square	Path
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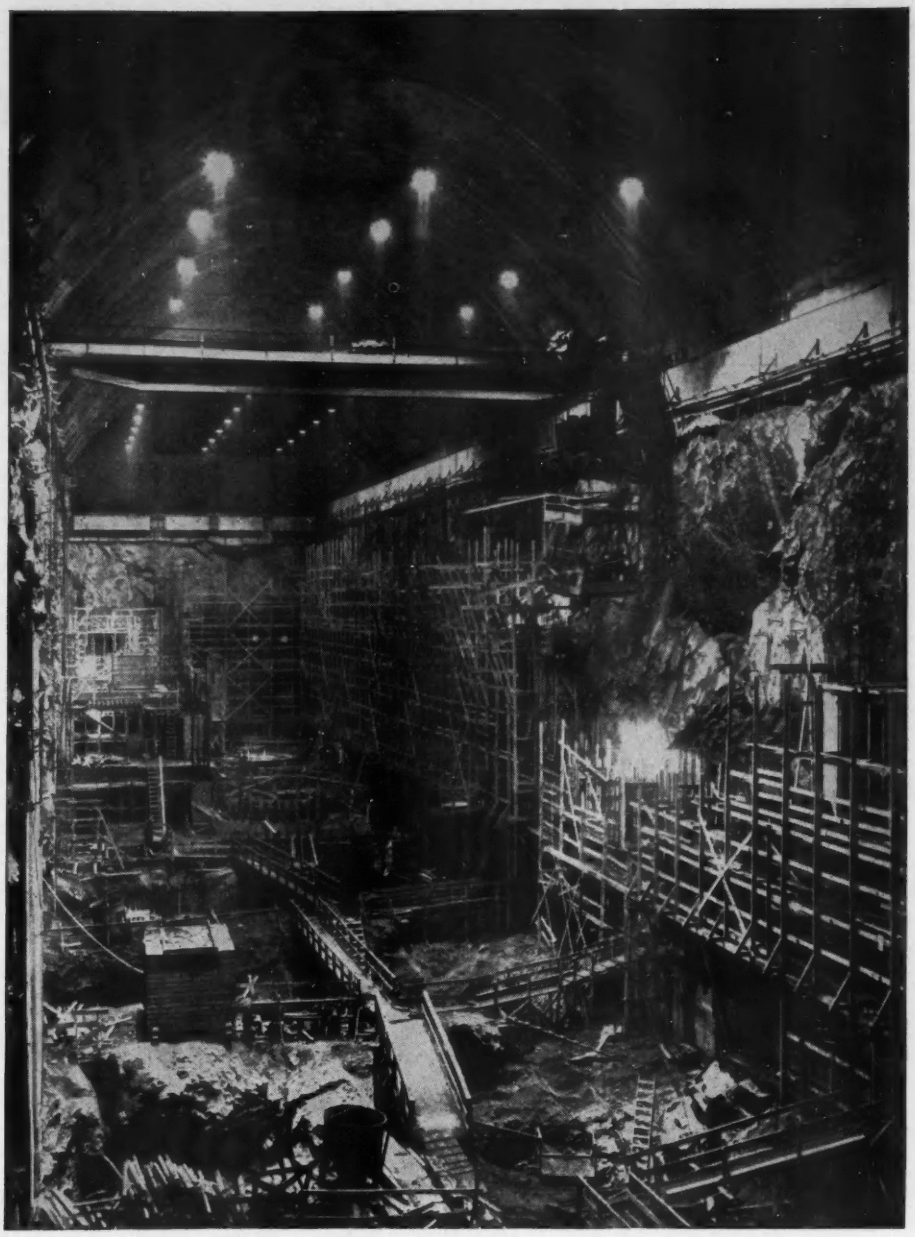

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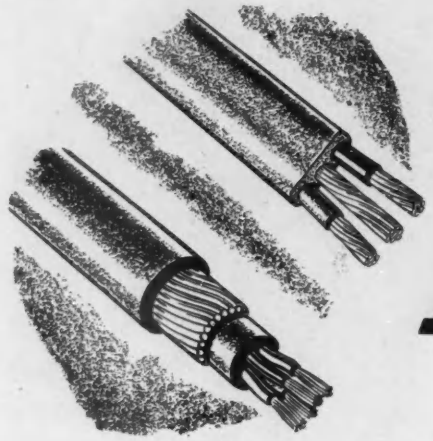

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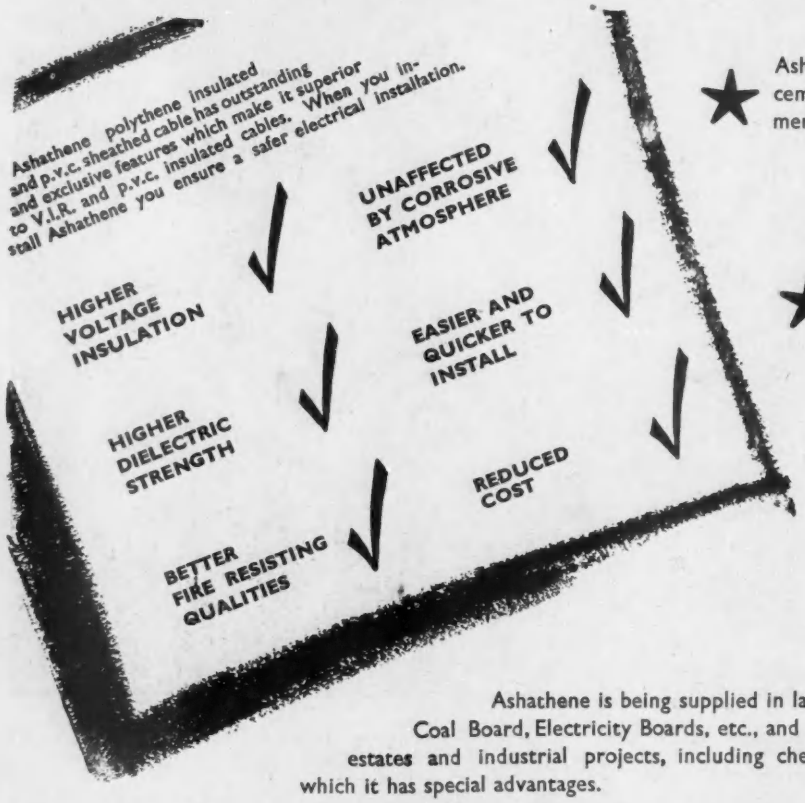
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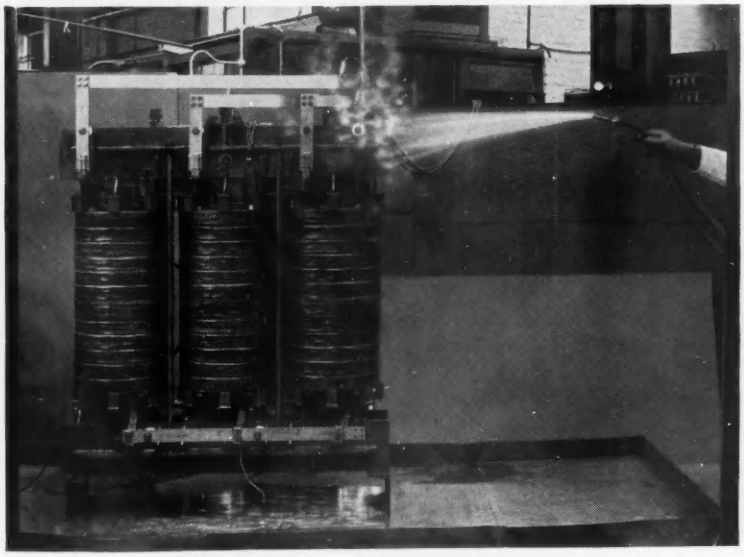

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